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ABSTRACT

This study continues the investigation of the general organizational plan used by good motor learners in acquiring a complex motor skill (tennis serve). The General Serve Problem Solving Model (GSPS), developed in earlier research, was utilized in an effort to improve and broaden it so that other types of learners may be studied and compared. Six subjects were observed over seven one-half hour learning sessions. They learned to serve by observing a loop film and still pictures and by asking questions. Results indicate that the model, in order to fit these six subjects, needed certain revisions. These are discussed. (Author/TL)

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STUDY OF THE COGNITIVE PLAN IN THE ACQUISITION OF COMPLEX MOTOR SKILL. CONTINUATION OF STUDY I: GOOD MOTOR LEARNERS

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April 1971

U.S. DEPARTMENT OF
HEALTH, EDUCATION, AND WELFARE

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ABSTRACT

The purpose of this study was to continue to investigate the general organizational plan used by good motor learners in acquiring a complex motor skill (tennis serve). It was hypothesized that the General Serve Problem-Solving model, developed in a prior study, would be followed for acceptable but not rejected problem solutions. Six subjects were observed over seven one-half hour learning sessions performing 3406 serves. They learned to serve by observing a loop film and still pictures and by asking questions. Both verbal and motor data were collected on video tape. The motor data were transcribed and coded serve-by-serve and analyzed by means of a computer program which assigned a value to each part of the serve and printed these individual parts with their respective values. The sum of these values for each serve was plotted and printed. Accuracy and speed scores for each serve were also analyzed and plotted. High scores, low scores, plateaus, and mean scores for motor performance, accuracy, and speed scores were analyzed. These records presented a detailed as well as general picture of what was happening in the performance of the serve. In order to analyze the verbal data, the data were divided into problems investigated by the subjects. These problems were analyzed by means of a Verbal-Motor Behavior Graph. These results were then processed by hand through the GSPS model to determine accuracy of the model and also to determine where and how learning takes place. Results indicated that the model, in order to fit these six subjects, needed the following revisions: order of reading the main properties CRT was changed to TRC; forward and mixed patterns for calling the properties were also included, although the reverse pattern still predominated; order of priority of the other properties was added. The model was revised according to the results of the experiment. High scores, low scores, and plateaus all appeared to perform important functions in the total learning situation when the Verbal-Motor Behavior Graph was consulted. Contrary to the results obtained in the first research, learning appeared to take place within the problems rather than between.

CHAPTER I

INTRODUCTION AND PURPOSES

The following two phenomena are often evident to those working with students: (1) a learner's concept of what he is doing and what he actually is doing are often quite different; (2) when a suggestion is given for improvement, the student appears to ignore the suggestion and continues with his own plan of attack. The frequent occurrence of these phenomena has prompted the experimenter to investigate the plan of attack used by learners in solving a complex motor task (a tennis serve). A further question is also involved: do all learners follow a similar plan of attack or are there as many plans as there are students? Knowledge of consistencies between plans of learners would help in teaching this skill; and, in that there are similarities between motor skills, the knowledge would help in teaching other motor skills. Teachers are aware that a motor performance test is an indication of progress in learning, but it does not explain what occurs between the instructor's initial demonstration and verbal explanation and the student's final test scores on that skill. This study attempts to bridge the gap between initial instructions and final performance.

The purpose of this research is to continue study on the plan of attack used by good motor learners in acquiring a complex motor skill (tennis serve). The initial study (Lindquist, 1968) presented a General Serve Problem Solving Model (GSPS)[1] that represented the plan used by one subject in learning to serve. This model employed some of the basic concepts used by Newell and Simon (1963) in developing the General Problem Solver (GPS) which simulates human problem solving. The initial study theorized that the model fits problems with acceptable solutions but not problems with rejected solutions. A brief account of this model appears in a previous research article (Lindquist, 1970).

In order to pursue the main purpose of the study, the following objectives were established prior to undertaking the project:

1. To collect, in depth, data on a sufficient number of good performers of a motor skill so that comparisons can be made between these learners.
2. To obtain more data in an effort to determine fit of the present GSPS model to other subjects of similar ability.
3. To improve the present model so that other types

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[1] See Appendix 1 for this model.

of learners may be studied and compared to the model in an effort to determine where discrepancies lie.

4. To study the learning process from the verbal/motor data collected on the six subjects to detect the following: where in the total process learning appears to take place, where stabilizing and fluctuating patterns appear and for what reasons, what types of pattern or plan the subjects follow in order to solve the problem of learning to serve through observation and asking questions, and what similarities and differences in these patterns or plans exist between subjects.
5. To begin to build a library of motor skills on video tape to assist students and faculty in analyzing complex skills.

Justifications and Limitations

Past research used motor performance data predominantly to the exclusion of other types of observable data, limiting our knowledge of what takes place during the learning process. Those who study human behavior are recognizing the necessity for the inclusion of a variety of types of data in order to more adequately explain what is happening to man while he learns. Kaufman (1968) substantiates the inclusion of numerous types of observable data in studying man--data such as movements, sighs, verbal data, and facial expressions. The model used as a means of study or explanation is useful in that it can include a large number of variables.

The experimenter recognizes that this study is in its beginning phase. The subjects are in a natural setting with as little interference as possible. Few variables are controlled, and those controlled are described under methodology. The study attempts to include all variables that impinge upon the human in an ordinary learning situation rather than to eliminate or control them. The study is based on a small select sample and any attempt to predict the model's applicability to other persons and situations must be done with this knowledge in mind. Although the possibility of gathering and analyzing a large amount of data on a large number of variables is present, this study will be limited to the analysis of certain variables that occur in the original GSPS model with the addition of certain factors that are directly related to clarifying the model.

Definition of Terms

The term "serve" is used to describe the total condition of the server's situation at a particular time, including position of the tennis ball, motor and verbal behaviors of the subject, and feedback from past serves. The term "variable" stands for the parts of the tennis serve: i.e., stance, grip, and height of ball toss. "Value" refers to the descriptive or numerical limitations attached to the variable. The term "property" denotes both variables and values of the serve. There are two types of values attached to variables. One is descriptive and used by the subject; the other is the numerical value assigned to the variable by the experimenter for purposes of analysis. At a certain time, the serve can be described by the variables (if a general description is desired), by values (if a more specific explanation is needed), or by the properties of the serve (if both variables and values are used in the description). The term "element" is used to describe a combination of properties into a larger unit. An example of the use of these terms appears below:

Variable--Vertical position of ball toss or T.

Value--Ball toss too high. The value "too high" is assigned by the subject to the variable ball toss or T.

Property--At a particular time and place "ball toss too high" equals the property since it includes both a variable and a value (whether assigned by the subject or experimenter). To the experimenter, "ball toss too high" equals T_3--a label much easier to work with and program. A value of 5 is attached to T_3 in determining "form" performance or motor performance of the subject.

Element--A combination of properties into a larger whole. An example is: ball toss (T) too high (T_3) + ball toss too far in front (C_5) + Stepping (S_9) = BALANCE ($\pm$). The subject has described the properties leading to the problem of balance and combined them under her own label. The experimenter has done the same with more easily coded symbols.

"Main Goal" equals speed and accuracy. These goals were presented to the subject by the experimenter. "Subgoal A" is the formation of balance, coordination, timing, rhythm, feeling, form and other elements described and labelled by the subject and experimenter. "Subgoal B" consists of adding of values, variables, properties, and elements; assigning of values to variables; assigning equivalences between values, variables, properties, or elements; and subtracting values, variables, properties, or elements. "Subgoal C" consists of reading in, calling, or testing values, variables, properties, and elements.

An "episode" is one serve plus the verbal/motor data related to that particular serve. A "problem" occurs in the verbal data of a subject. It is marked by a stated goal and ends in either accepting, rejecting, tentatively accepting or rejecting, or setting aside of that goal. A "plateau" occurs when four or more individual episodes or large problems have the same score (depending upon the data analyzed). A "transition period" occurs when there are three or more serves without verbal data. "Forgetting" is the resulting condition of a decrease in motor score between problems within or between days. "Remembering" is the term used to describe the condition that exists when a serve score remains the same between problems within or between days. The term "learning" describes two conditions: (1) the result of an increase in motor score between problems within and between days and (2) the subject's use of various operations to solve the problems, which may or may not result in an increase in motor scores.

CHAPTER II

PROCEDURES FOR GATHERING DATA

Equipment. A General Electric Type TE22 Vidicon Camera with Angenieux 15 X 150 mm. lens was used to collect the motor data. The verbal data were collected simultaneously on an Ampex VR660B recorder. A Vega wireless microphone was used on the subject,and the subject's voice was recorded on audio track one. Serve identification was recorded separately on audio track two. The tennis court was set up for Hewitt's serve tests (1966). A card table was placed in back of the baseline on the tennis court behind the subject and a Super X loop film projector with loop on the tennis serve (Athletic Institute) was placed on the table together with still pictures (Driver, 1964 and Gould, 1964).

Personnel. A television supervisor and one technician were present at all filmings and recordings. An extra person recorded serves on a hand counter while one technician recorded the number verbally onto track two of the tape while the subject served. Two graduate assistants recorded accuracy and speed scores on all serves on special recording sheets,[1] assisted in setting up and taking down equipment, and helped to gather balls. They also administered the Scott-French Wallboard Revision of the Dyer Test (1959).

Subjects. Posters were made announcing the need for subjects and the necessary qualifications which were: female, right-handed, good in motor skills, freshmen, and no previous tennis lessons. The subjects were paid for six one-half hour learning sessions. Those responding were questioned as to their suitability and availability during Easter vacation. Five subjects were selected from those applying; a sixth subject was added on the second day due to technical difficulties with one subject. The difficulties were minor and the data on all six subjects were used in the study.

Schedule for gathering data. Dates for filming were scheduled over Easter vacation due to availability of equipment and technicians at that time. The following dates were selected: March 20, 21, 23, 24, 25, 26, and 27. Although wind and cold weather prevailed on some of these dates, no changes in schedule had to be made. Each subject was scheduled to appear on each half hour beginning at 8:30 a.m. The equipment and courts were prepared prior to their arrival. On the first day each subject was given the wallboard test to determine initial ability. This is a test of agility, hand-eye coordination, ability to hit forehands and backhands against a board within a certain period of time, and ability to use a long lever. Since none of the girls knew how to serve, a preliminary serve test did not seem feasible. Although the relationship between the wall-board test and serving may be questioned, a preliminary measurement of where each girl stood on the above-mentioned skills in relationship to 250 other beginning students who had previously taken the test was obtained.[1] Each subject then listened to instructions which were prerecorded.[2] These instructions contained the main goals of accuracy and speed as well as the idea of form. Subjects were instructed not to observe each other, practice, or even to think about serving outside of the learning sessions. Each subject reported at her specified time on each of the seven days. She was instructed to watch the loops, still pictures, serve, ask questions, or rest whenever she needed for her half hour. The last 10 serves were Hewitt test serves and the subject was informed when these were taken, although the results of all of the serves were recorded in the same manner as the test serves. Testing equipment remained stationary for all serves. On the seventh day the subjects observed the last part of their previous day's performance. Each subject was in as natural a setting as possible except for the presence of extra equipment, personnel, and the Vega microphone around her neck. Each subject had a bucket of balls and a choice of tennis racket. The foot fault rule was introduced at the beginning of the second day. Each day thereafter the subjects were instructed to proceed as they wished. The entire session for each subject was recorded on video tape.

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[1] See Appendix II for a sample of these sheets.

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[1] See Appendix VI of reference (1) for these norms.

[2] See Appendix III for these instructions.

CHAPTER III

METHODS OF ANALYSIS

Individual Subject Analysis

Methods for analyzing motor data. The wallboard scores for each subject were recorded, T-scores assigned, and preliminary comparisons between subjects made. The Hewitt serve achievement test scores were taken at the end of each session. These were analyzed by comparing them to test norms. Accuracy and speed mean daily scores were calculated and tabulated for comparison purposes. Prior to the study, Motor Behavior Analysis Sheets[1] were devised on which parts of the serve were coded and values assigned to each variable according to expert opinion. Each serve was analyzed on a separate sheet. The video tapes were played and still-framed as necessary in order to determine each serve part. Since each subject served between 470 and 650 serves in seven days, the analysis amounted to observing 3406 serves. A television technician and a graduate assistant aided the experimenter in running the recorder, observing, and transcribing the motor data. Only track two giving the number of the serve was played while the motor data were being transcribed onto the Motor Behavior Analysis Sheets. In order to prevent these data from biasing the motor analysis, the verbal data were not played. This process took over two months' time, the experimenter working several hours per day during the week and all day Saturday. The Motor Performance Plot Program (form data), which was previously written for the IBM 360 computer, was altered to run on the CDC 3300. This program assigns values to each part of the serve, totals the values, plots the motor performance scores, and prints out the serve number, score, and plot of each serve.[2] Plots of both accuracy and speed scores and print-outs of these scores were added to this computer program so that these three plots and scores parallel each other for easy inspection. Print-outs of the punched IBM cards were used to examine the individual scores for each serve. A Commodore calculator was used to analyze the data on each problem; this was faster than trying to program the computer to find this data on problems that could range from one serve to any number of serves.

Methods for analyzing verbal data. The verbal data were placed on regular tape to be analyzed separately. A stereo recorder was rented in order to transcribe the verbal data onto Verbal Data Recording Sheets,[1] which was done by a graduate assistant. The serve number was verified by switching to the second track. The experimenter divided the verbal data of each subject into problems. The problem solutions were evaluated according to the following results and coded according to the corresponding number:

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[1] See Appendix IV for a sample sheet.

[2] The maximum score a subject can achieve is 70. An intermediate-advanced player on the intercollegiate tennis team at San Jose State College scored 60.

1. Subject tentatively accepts the serve and solution = ?.
2. Subject rejects the serve and solution = -.
3. Subject accepts serve and solution = +.
4. Subject rejects serve, accepts solution = - +.
5. Subject accepts serve, rejects solution = + -.
6. TR = transition period.
7. TEST = Hewitt serve test period.

Each set of verbal data was analyzed using information-processing techniques which resulted in a Verbal-Motor Behavior Graph for each subject. A synopsis was made of the results obtained in this graph. The order of reading in variables, properties, and elements; the order of acceptance of the CRT[2] properties; the order of call of the CRT values; model changes, and the general pattern employed in solving the problem were recorded for each subject.

Combined analysis of the Verbal-Motor data. In an attempt to combine the two sets of data, the verbal problems of each subject were analyzed using motor plot, accuracy, and speed scores. For each problem the initial, final, mean, and highest scores of motor plot, accuracy, and speed scores were investigated. Reasons for high and low scores as well as plateaus were investigated in the Verbal-Motor Behavior Graph.

Increases and decreases between and within days in motor performance, accuracy and speed scores by problems with and without rest were analyzed for each subject. The highest motor performance accuracy and speed scores of each subject for each problem were analyzed by employing the Verbal Motor Behavior Graph data in order to determine reasons for these high scores. General patterns were described for each subject using only the data relevant to these highest scores per problem. These included a study of the highest of these high scores, the lowest of the high scores, and the plateaus.

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[1] See Appendix V for a sample sheet.

[2] The CRT variables are the 3 main variables used in the GSPS model of the previous subject. C = horizontal position of ball toss; R = position of the face of the racket on contact, and T = vertical position of ball toss.

Group Analysis

Methods for analyzing motor data. The data for all the subjects were compared in an attempt to determine similarities and differences between subjects. The subjects were ranked according to the results of the wallboard test scores in order to determine initial motor ability and also to determine the ability of this test to predict final performance on the other motor scores for these six subjects. The other motor scores included the Hewitt serve tests, mean daily accuracy and speed scores, and mean motor performance scores. In order to do this, the subjects were ranked on the wallboard test; then the rank order for all the other tests combined was determined and comparisons were made between the scores.

Methods for analyzing the verbal data and combining the verbal-motor analysis. The mean daily accuracy, speed, and motor performance scores were tabulated for all the subjects in order to determine consistent patterns of high scores, low scores and plateaus. The number, time, and order in which subjects read-in properties were tabulated in order to compare these with the verbal data to determine consistent patterns. In order to analyze these, the following criterion was used: those properties considered by three subjects or less were considered properties individual to the subject; those considered by more than three subjects were considered consistent among subjects. The properties read in by all subjects appear first in the order of priority. This order was determined by adding all the positions of reading in the variables. Next, the properties considered by five subjects were computed, followed by four and three. These results were recorded in order to determine priority for calling properties and elements. The lowest scoring of these properties and elements in each group would have the highest priority since they were called the earliest by most subjects.

The order of reading in the CRT variables for all subjects was analyzed by recording the orders used by all six subjects and determining the most frequent pattern. The most prevalent pattern for reading in properties was determined by tabulating all the patterns for all the problems for each subject and summing these. The most prevalent pattern for initial calling of the values of the CRT properties was determined by tabulating the order of reading in each of these values for each subject. The order of priority may differ from the order of calling of the variables since they are determined differently.

The between-day increases and decreases and scores remaining the same for motor performance, accuracy and speed scores were tabulated for all the subjects. Analysis was made by summing the frequency of these scores. How much increase and decrease could possibly by attributed to reminiscence, forgetting, or remembering between days was ascertained.

The within-day increases, decreases and scores remaining the same for motor performance scores, accuracy and speed scores for all subjects was tabulated. These were summed, and frequency of each of these determined. Increases, decreases and scores remaining the same with and without rest were then analyzed in order to determine how much credit for increases and decreases could possibly be attributed to dissipation or accumulation of fatigue factors or short term decay and how much might be due to other factors.

In an effort to determine consistent patterns between subjects analysis of the highest scores in each problem was made by comparing the pattern used by each subject in achieving the highest of these high scores, the lowest of these high scores, and the plateaus.

CHAPTER IV

RESULTS AND DISCUSSION

Subject One

Motor data. The subject had a raw score of 22 on the wallboard test which was in the 40th percentile (T-Score 47). This indicates she was slightly below average on this initial test. Her ranking was 4 in comparison to the other subjects. On the Hewitt serve accuracy test[1] her raw scores ranged from 7 on day 1 to 12 on day 7. Her ranking was 5. On the Hewitt serve speed test her scores ranged from 4 on day 1 to 11 on day 7. Her low score was 0 on day 2. The range of T-Scores was 38-70. Her ranking was 4 in comparison to the other subjects. Her range of mean daily scores[2] went from .38 on day 2 to .88 on day 7. Her ranking was 5. Her mean daily speed scores[3] ranged from .29 on day 2 to .88 on day 7. Her ranking was 3. Since these scores were taken only on the research subjects, there were no norms with which to compare them. The range of mean motor performance scores went from 4 on day 2 to 59 on day 2. Her ranking was 2.

In considering the accuracy and speed scores, this subject performed according to the usual expectation: low scores occurred on days 1 and 2 and high scores on day 7. On the motor performance test she was atypical: low and high scores both occurred on day 2. On her total composite score her rank order was 3. Her predictive score would have placed her 4.

Verbal data. The order the subject read in properties and elements[4] was rhythm, backswing, vertical position of ball toss, horizontal position of ball toss, movement on the court, accuracy, wrist, contact on center of the strings, coordination, the ball hit down, speed, the ball hit diagonally, timing, simultaneous toss and swing, position of the racket face, choked grip, reach, the whole body, follow through, "ping-pong" concept, whole arm, contact on top of the ball, type of grip, warmup, and wind. The subject started with an element; position of the racket face was read in late. She went from elements to variables, values, and properties, and then again to elements--from simple goals or ideas to more complex concepts, from large body problems to small problems such as grip. The position of the ball toss predominated the program early and maintained its prime position throughout the program. Racket face position did not hold a position of importance.

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[1] See Appendix VII.

[2] See Appendix VIII. [3] Ibid.

[4] See Appendix IX for a detailed analysis which includes the order of assigning values.

In analyzing the Verbal Motor Behavior Graph[1] as to agreements and disagreements with the GSPS model, the CRT variables[2] were investigated first. CRT was not the order in which the subject accepted these variables; TCR or possibly TRC would be more descriptive of the order used for both accepted and rejected solutions to the problems. The order of accepting variables followed all three types of patterms: forward, reverse, and mixed. With the rejected solutions, the forward order prevailed; with the accepted solutions, the mixed order prevailed. As shown in the motor plot scores, the subject reached a state of plateauing early and she also reached a high skill level early. Negative solutions prevailed in her plan. The order of call of the CRT variables was: $C = C_3, C_1, C_4, C_3$, and C_1; $R = R_2, R_1$; $T = T_2, T_3$, and T_1. In scanning for variables the subject often went back and forth selecting variables rather than in a straight forward and/or reverse direction. In fact, she had more success with her solutions to problems if she followed this scanning or mixed pattern.

Combined verbal/motor analysis. In analyzing the verbal problems by the motor performance scores,[3] the range of scores went from 24 on day 1 to 59 on day 2. This subject reached a high skill level early, plateaued at a high score of 52 for 9 problems; her score rose again to 55 for 2 problems, plateaued again at 52 for most of the remainder of the program. If we plot the high scores as in Figure 1, we see a "strange" learning curve. In examining these highest motor scores[4] we find that 37 of these scores occurred without any benefit of rest and 1 followed a brief rest while gathering balls. Although one rise in score could be attributed to the factor of the dissipation of fatigue factors, we must look elsewhere for the explanation in the case of the other 36 high scores. During one very high score the subject was in a testing period, and it may be that the pressure of the test motivated her to achieve higher. The following pattern exists for the plateaus: the subject was combining variables individually, or combining variables into

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[1] See Appendix X for the complete graph and Appendix XI for a symopsis of the graph.

[2] See Appendix XI for this analysis.

[3] See Appendix XII. [4] See Appendix XIII.

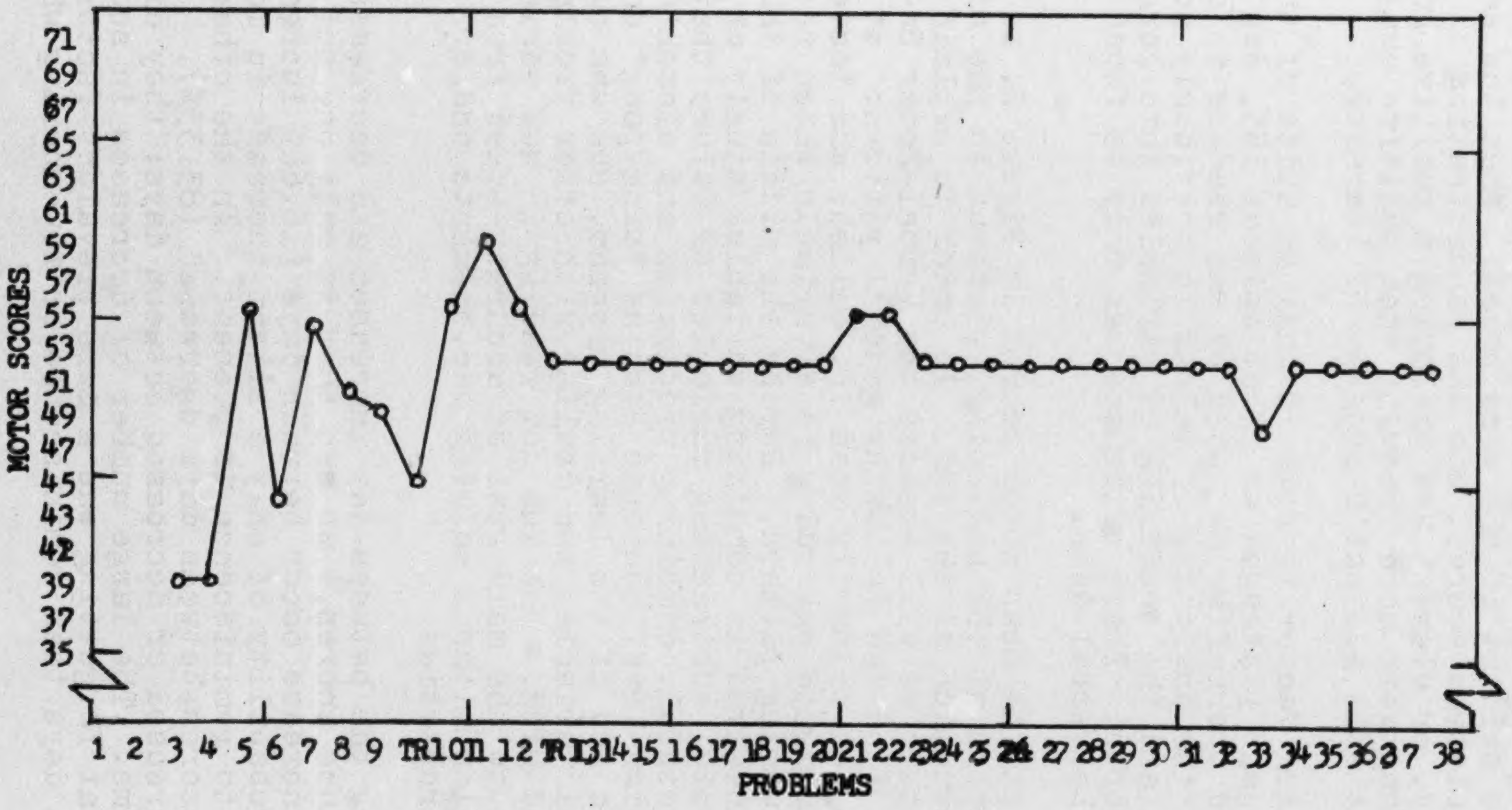

Figure 1.--Subject One. Plot of high motor performance scores by problems.

larger motor patterns such as timing or what the subject called "the whole serve." Contrary to one theory for plateaus, the lack of motivation, it appears that the subject was highly motivated and very actively at work. She was combining properties into larger elements and appeared to be working with a large number of variables rather than not enough as would be evident if she were bored. When the scores exceeded 52 (the plateau score), she was concentrating on one variable, property, or element and employing a positive goal. Negative evaluations were more frequent than positive evaluations throughout this subject's program of learning.

An interesting factor to note is that in spite of the fact that the subject plateaued at 52 at episode 165, day 3, learning continued thereafter as noted by the reading in of 15 new variables, the assigning of values to previously accepted variables, and the combining of variables into larger elements and concepts. These evidences can only be found in the analysis of the verbal data.

In looking at the mean motor scores in Figure 2, we find much fluctuation at the beginning, plateaus in the middle and more fluctuation at the end. In order to explain the total general pattern we will examine the Verbal-Motor Behavior Graph. We find the following general pattern: at the beginning the subject primarily read in, called, and tested one variable or assigned one value to a variable which resulted in a fluctuating pattern. During the middle of the program she was involved in combining variables singly or into larger elements, subtracting variables or values that had not been successful, combining properties and elements, or working with high-level concepts such as "ping-pong" concept. Towards the end of the learning program, she was again testing individual variables and dealing with other problems such as warmup and wind. She was not reading in new variables but went directly to the main goal of accuracy-speed from the individual variables without calling the elements and/or combinations of properties.

In examining the between-day increases and decreases in motor performance scores,[1] we see that in only one out of six days did an increase occur between days (16.66% increase). Therefore, the probability of only a slight increase in motor scores being due to reminiscence is present. In the other five instances, scores between days decreased (83.33%). Scores either increased or decreased between days; they did not remain the same. The large number of decreases in scores would indicate that forgetting was a more prevalent factor occurring between days than reminiscence or remembering when

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[1] See Appendix XIV.

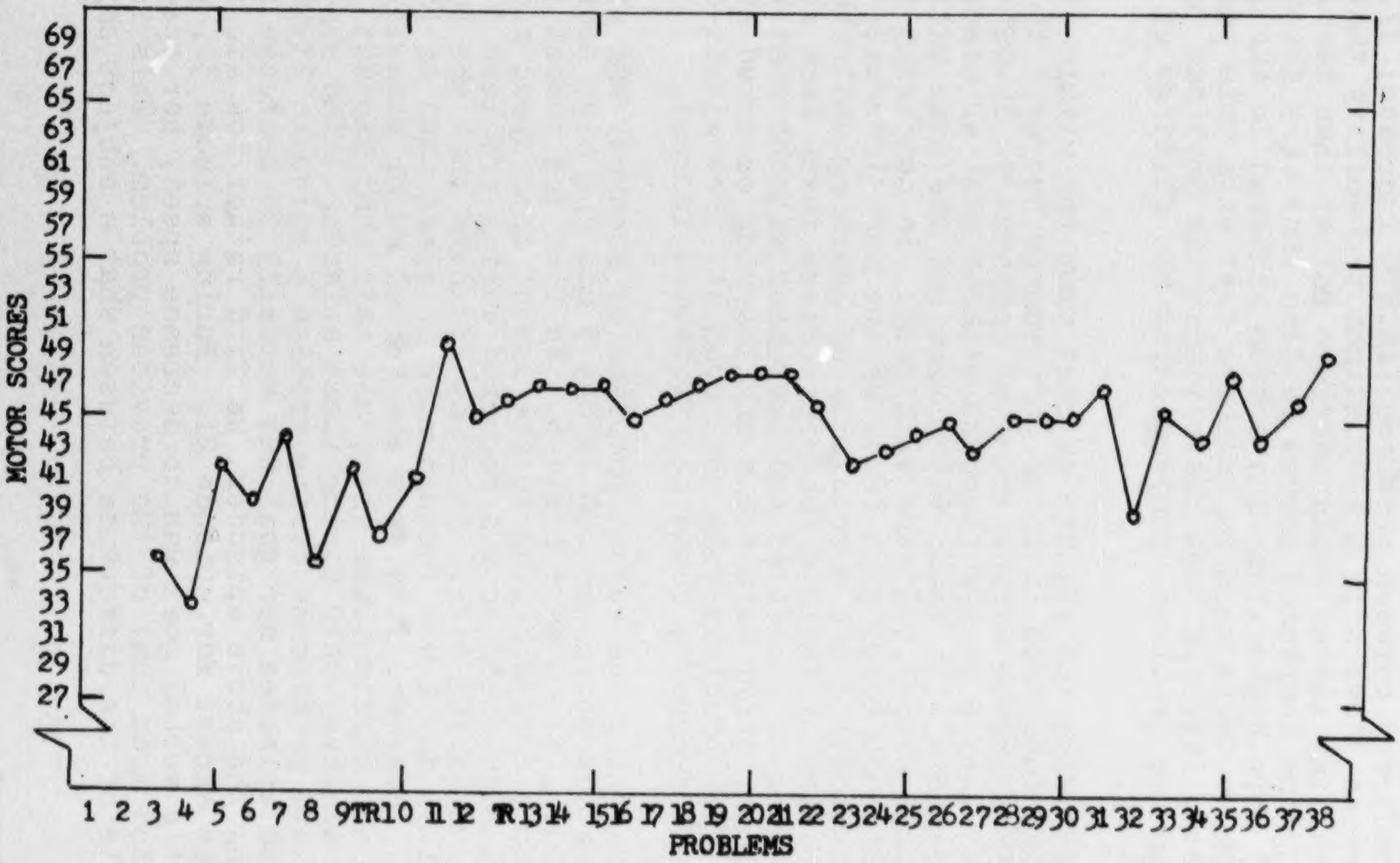

Figure 2.--Subject One. Plot of mean motor performance scores by problems.

using motor performance scores as the criterion of learning.

Within-day increases and decreases in motor performance scores[1] reveal that an almost equal number of increases and decreases occurred between problems (46.87% increase; 37.50% decrease) which shows only a very slight probability that the subject's initial scores would increase rather than decrease. In examining the increased scores we find that very few initial scores were higher than any scores achieved in the prior problem. These facts seem to indicate that with this particular subject, learning took place within the problems rather than between the problems, contradicting the findings of the previous study.

In examining the effects of rest upon the within-day increases and decreases in motor performance scores,[2] there was a 31.25% increase without rest as compared to 15.62% increase with rest; a 28.12% increase without rest as compared to 9.37% decrease with rest; 5.52% remained the same without rest and 0.00% stayed the same with rest. In comparing the increases and decreases with rest, we see more increases than decreases indicating the possibility of learning contribution from dissipation of fatigue factors. Since there were about an equal number of increases and decreases without rest between problems, short term decay and learning occurred about equally between problems with this subject. Few within-day increases and decreases could be attributed to rest.

In analyzing the verbal problems by accuracy and speed scores,[3] the low score was .00 on day 5 and the high scores were 1.33 and 1.31 on days 1 and 6. We find the lowest mean accuracy score corresponding to the lowest mean speed score. The highest mean speed scores occurred during problems 3 and 4 on day 1, episodes 8-22. This may indicate that the subject's goal on day 1 was focused more on speed than on the other days. However, data from the Verbal Motor Behavior Graph does not substantiate this; she said that she was working on accuracy only during these episodes. The speed goal came into prominence during problem 5 episodes 23-28. During these episodes her goal was actually to decrease speed. In examining the above episodes, we find rather low average speed scores except for episode 21. During episode 32, where the subject's verbal goal was to decrease speed, her speed score doubled from that of the previous problem. This is a good example of the difference between what a subject says and does.

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[1] See Appendix XIV.

[2] See Appendix XV.

[3] See Appendix XVI.

In examining the plot of high scores only, as shown in Figure 3, we see a widely fluctuating pattern of accuracy scores. Upon examination of the high scores at TR after 9, 10, 14, 16, 32, and 34, the following similarities can be seen: accuracy goal; the subject performed the following operations--called variables and properties, assigned values to variables, called T or TC only, and employed a mixed or reverse pattern in calling variables and properties. At the lowest of the highest scores, 23 and 25, we see the following similarities: accuracy goal; the subject called variables and properties, assigned or called values. In looking at the highest speed scores in Figure 3, there were many scores at 3 (her highest score). This is a high score for women. At the plateau (problems 13-22) we see mostly accuracy goals (in problems 17, 20, 21, 22 there were speed goals also). She was working on the element timing, adding properties to produce an increase in speed, and was adding the following variables and properties: WH + WB + S at episode 22.

In examining the plot of the mean accuracy and speed scores in Figure 4, we see a very fluctuating pattern without plateaus. The lack of plateaus in the data might indicate that accuracy and speed goals took precedence over form or "feeling good" goals at this particular point in the program. Mean performance scores levelled off during problems 12-22; whereas from 12-14 we see a rise in the accuracy and speed goals followed by a fall from problems 16-18, a rise in 19, a fall in 20, a rise at 21, and a fall at 22. One explanation for the fall at the beginning and end of the program is that the subject is working on form goals at these points. Speed and accuracy goals are also noticed at the beginning of the program, in the middle, and again towards the end. The variables, properties, and elements combined in the center of the program consist of speed, accuracy, and form goals.

In referring to the Verbal-Motor Behavior Graph, increases and decreases appear to be due to the reading in, calling, assigning values, adding, subtracting, assigning equivalencies, testing variables, properties, and elements related to the problem. Both increases and decreases appear to be necessary parts of the learning process, since assigning values and testing of eventually unsuccessful properties are parts of these processes. It is possible that if the conditions of learning had been more controlled and the subject fed variables and properties under highly controlled conditions, the results might have been different. There were times in the learning situation, however, when the subject asked for a specific answer, got it, and did not use the information until days later so that there is some evidence that the subject would pursue her own plan of attack in solving the problem even under controlled conditions.

The following results can be seen upon examination of

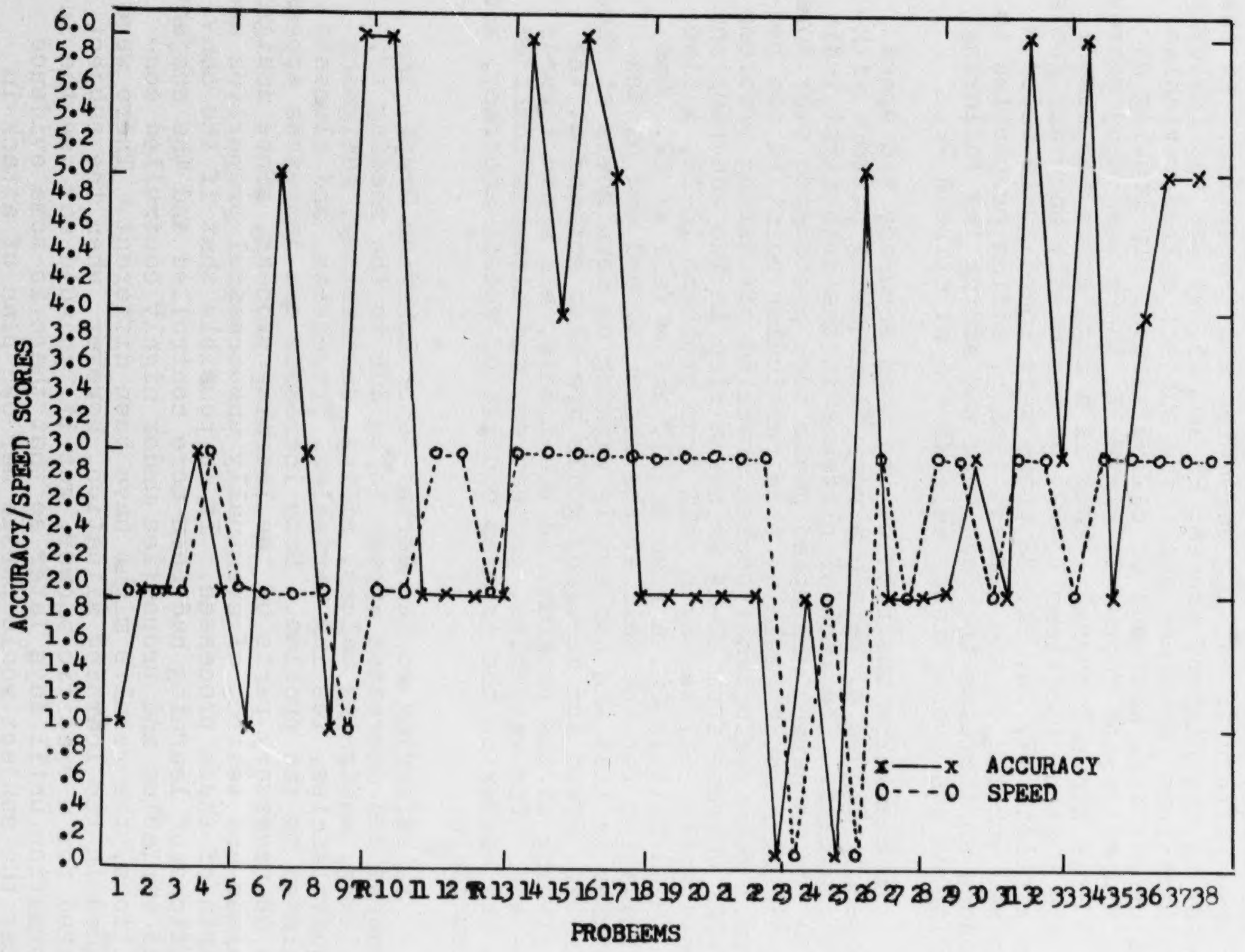

Figure 3.--Subject One. Plot of high accuracy and speed scores by problems. (Maximum accuracy score = 6. Maximum speed score = 4).

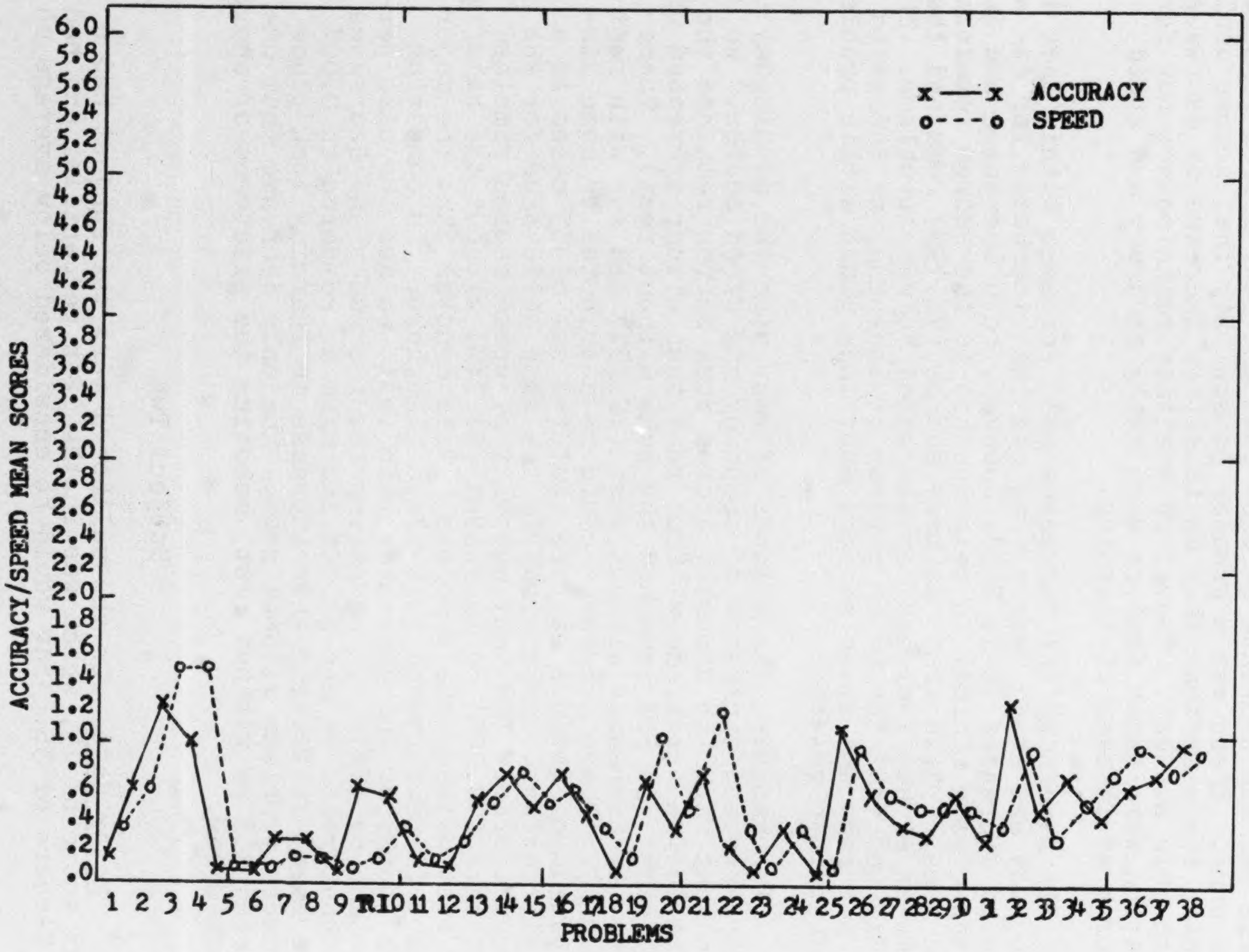

Figure 4.--Subject One. Plot of mean accuracy and speed scores by problems.

the accuracy and speed scores between days.[1] Only one increase in both accuracy and speed scores took place between days. This 16.66% increase could be attributed to reminiscence. There was one decrease between days and four scores remained the same. There was a greater possibility that scores would remain the same than they would either increase or decrease with this subject. Therefore, neither reminiscence nor forgetting were major factors when using accuracy and speed scores as indexes of learning.

In examining the increases and decreases within days in accuracy and speed scores,[2] we see that increases far exceeded decreases (8-1; 9-1); however, both increases and decreases were minimal in relationship to the scores remaining the same. Three times as many scores (71.79%) remained the same as either increased or decreased between problems. This indicates that the major portion of learning, as indicated in accuracy and speed scores, must take place within problems rather than between.

In examining the effects of rest upon the within-day increases and decreases of accuracy and speed scores,[3] we see that with the accuracy scores more scores remained the same between problems without rest than either increased or decreased (51.51% remained the same without rest). There were six increases without rest (18.18%) and two with rest (6.06%). These increases could be attributed to some dissipation of fatigue factors, but two out of 33 cases is a small portion. Approximately the same holds true for the speed scores. The vast majority of speed scores remained the same (57.57%) or increased (24.24%) without the benefit of rest between the problems. This denotes that the major jumps in performance took place elsewhere. In comparing the increases and decreases with rest, we see the same percentage (3.03%). In comparing the increases and decreases without rest, we see 24.24% increase as compared to 0.00% decrease, indicating this increase in learning took place between problems without rest. The only decrease that occurred did so without rest, denoting the existence of short term decay.

Subject Two

Motor data. On the wallboard test the subject had a raw score of 15, which was in the 12th percentile, and had a T-score of 38. She would be considered below average on this pre-test as compared to 250 other beginning students. Her rank order on this test compared to the other 5 subjects was 5. On the Hewitt serve accuracy test[1] her scores ranged from 6 (T-Score 58) on day 5 to 19 (T-Score 80) on day 4. This was an unexpected result in that the highest score preceded the lowest, and these scores both occurred in the middle of the learning sessions. Her rank order on this test was 1. On the Hewitt serve speed test[2] her scores ranged from 5 (T-Score 58) on days 5 and 7 to 10 (T-Score 69) on day 3--again, a unique pattern. Her ranking was 2. The mean daily accuracy scores[3] went from .72 on day 4 to 1.10 on day 3. This was an unexpected result in that the highest score occurred prior to the lowest score and both occurred in the middle of the program. Her ranking was 3. Her mean daily speed scores[4] went from .43 on day 7 to .69 on day 3 which is as unique as her mean accuracy scores. Her ranking was 4 on these scores. On the mean motor performance scores, the range went from 8 on day 1 to 52 on day 7, an unexpected pattern. Her ranking was 5 on this test. The wallboard test was a good predictor of this outcome.

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[1] See Appendix XVII. [2] Ibid.

[3] See Appendix XVIII.

In looking at the composite results on these motor data, we find that the subject was atypical. For all except the motor performance scores her low scores appeared after the high scores. Her high scores appeared on days 3 and 4, her low scores on days 4, 5, and 7. On the total composite motor score her rank order was 4. Her predictive score placed her 5.

Verbal data. The order the subject read in variables, properties, and elements[5] was: vertical position of ball toss, position of racket face, speed, accuracy, step, bent knees, wrist turned horizontally, follow through, body lean to the left, starting position, type of grip, timing, racket dropped, ball hit down, horizontal position of ball toss, wrist--flexed or hyperextended positions, foot fault, whole body, simultaneous toss and swing, backswing, contact the ball off center, swing higher, sidearm, control over the racket, reach, contact made on top of the ball, head of the racket comes up, arch, ball contacted overhead, and wind.

The subject started with one of the three subgoals CRT, read in another and attacked the third in the middle of the program. She read in the main goals of speed and accuracy next. She read in single variables first and about the center of the program tried larger elements and concepts involving more than one variable or property.

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[1] See Appendix XIX. [2] Ibid.

[3] See Appendix XX. [4] Ibid.

[5] See Appendix XXI.

In analyzing the Verbal Motor Behavior Graph[1] as to agreements and disagreements with the GSPS model, the CRT variables[2] were investigated first. The CRT variables were read in in the following order: TRC. She added information on R to T. T and R combinations were considered most frequently; C was not attacked as often. (Subject 1 attacked T and C frequently, R infrequently). In consideration of the pattern used to call variables, for the problems with positively accepted solutions, the forward calling of variables prevailed; with the rejected problem solutions, a mixed pattern prevailed. This result did not agree with the previous model in that the subject for the first model called variables in reverse order for acceptable solutions. It can be noted that all three patterns (forward, reverse, and mixed) were found in the calling of variables for all three types of problems. For subject two there was a large number of repetitions of variables in testing and retesting. A reverse pattern was evident in calling values rather than variables. The order of call of the C variable was: C_3, C_2, C_4, and C_1. The order of call of the R variable was: R_4 and R_1; she did not consider R_3 or R_2. The order of call of the values of the T variable was T_2, T_3, and T_1. The order of call of the C values differed from both the first experimental subject and Subject One of this experiment. The order of call of T values was the same for both the first experimental subject and Subject One of this experiment. Subject Two substituted R_4 for R_2 and R_3.

Combined verbal/motor analysis. In analyzing the verbal problems by motor performance scores,[3] we find that the range of scores went from 8 on day 1 to 52 on day 7. The subject followed a typical pattern of expectation in her motor plot improvement. Her high scores did not plateau as did Subject One's scores but followed a fluctuating pattern as seen in Figure 5. The pattern of high scores could be described as rising, but fluctuating. If we examine these highest scores further, we find that 40 out of 41 cases appeared within rather than between problems. Only one appeared between problems and this appeared after rest. The

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[1] See Appendix XXII for the complete graph, Appendix VI for the explanation of the coded variables and values, and Appendix XXIII for a synopsis of the graph.

[2] See Appendix XXIII for the complete analysis.

[3] See Appendix XXIV for the complete analysis.

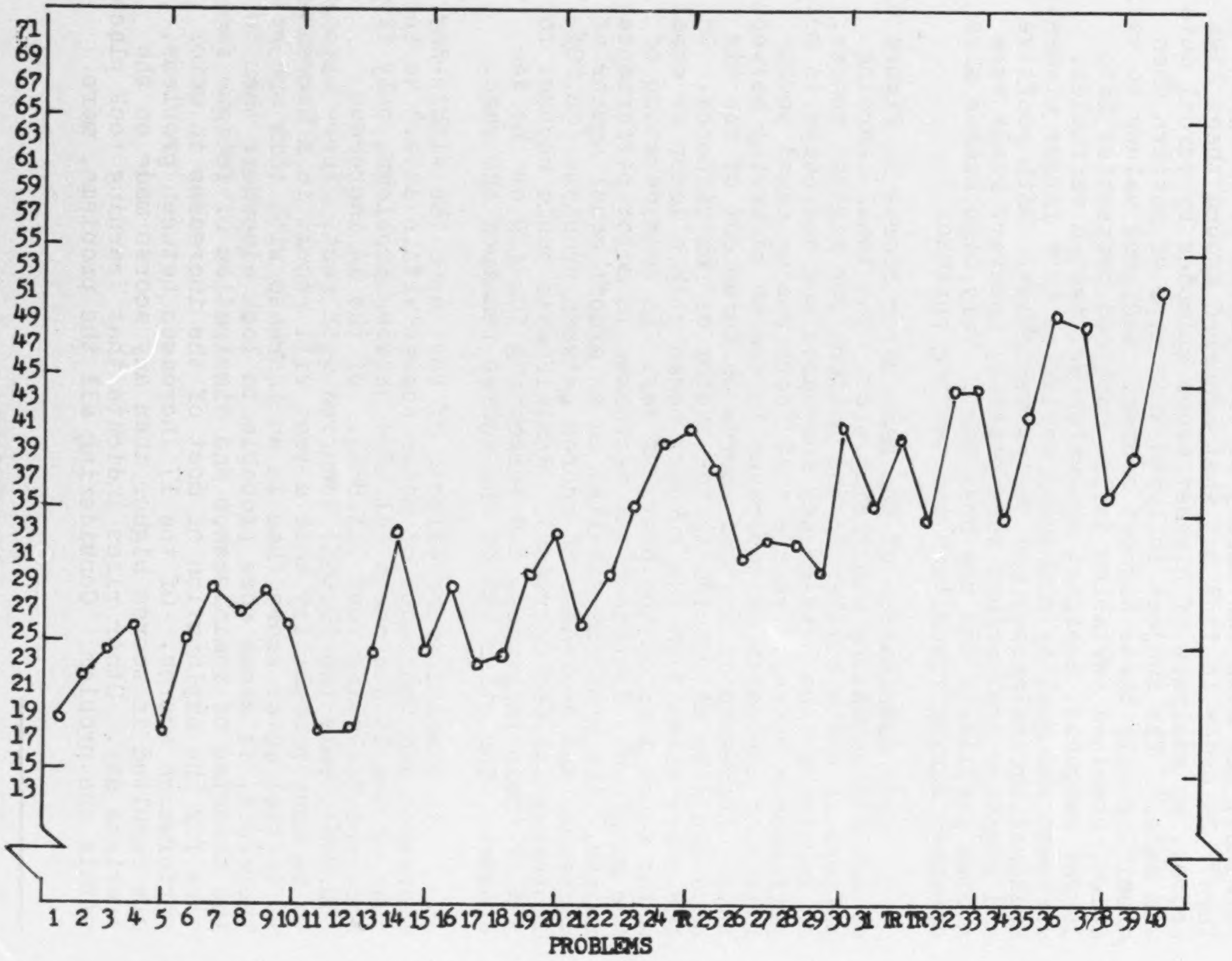

Figure 5.--Subject Two. Plot of high motor performance scores by problems.

theory of reminiscence does not explain these rises in performance, nor does the theory of dissipation of fatigue factors. In order to find out what occurred around these high scores, an analysis of highest score episodes by verbal data was made.[1] The subject followed this type of pattern when examining only these highest scores: assigned values to variables, combined variables early, combined properties into larger subgoals, assigned equivalences, tested variables, narrowed the goal by combining variables into larger elements, assigned equivalences, and tested variables. Both positive and negative evaluations were present; however, goals were stated positively for the most part. Very high scores also appeared during transition and testing periods.

Upon examination of the mean motor scores in Figure 6, we see a fluctuating but rising plot. The total learning pattern is quite similar to the pattern for highest scores. In looking at the between-day increases and decreases in motor performance scores,[2] we see that there was an equal possibility of increases or decreases in scores occurring between days. Increases in initial scores on three out of the six days could be attributed to the factor of reminiscence. On the other three days the subject began with a lower or equal motor score than on the previous day. In consideration of the within-day increases and decreases in motor performance scores,[3] the problems resulted in an almost equal number of increases and decreases in scores between problems (38.88% increase; 41.66% decrease). Reminiscence could account for 39% of these increases, and forgetting for 42% of the decreases. The other 19% of the scores remained the same.

In examining the effects of rest upon the within-day increases and decreases of motor scores within days.[4] we see that of the 15 decreases (41.66%) between problems, only five occurred following rest (13.88%). Of the 14 increases (38.88%), only two (5.55%) occurred with rest. There appears to be more probability that a rest will result in a decrease in initial motor score than in an increase with this subject. Therefore, it seems more probable to look elsewhere than to the theories of reminiscence and dissipation of fatigue factors for the explanation of most of the increases in motor performance scores. Of the 17 increases between problems, six resulted in scores higher than any scores made on the previous day. Other rises indicate that learning took place within the problem. Considering all the problems, more

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[1] See Appendix XXV for the complete analysis.

[2] See Appendix XXVI. [3] Ibid.

[4] See Appendix XXVII.

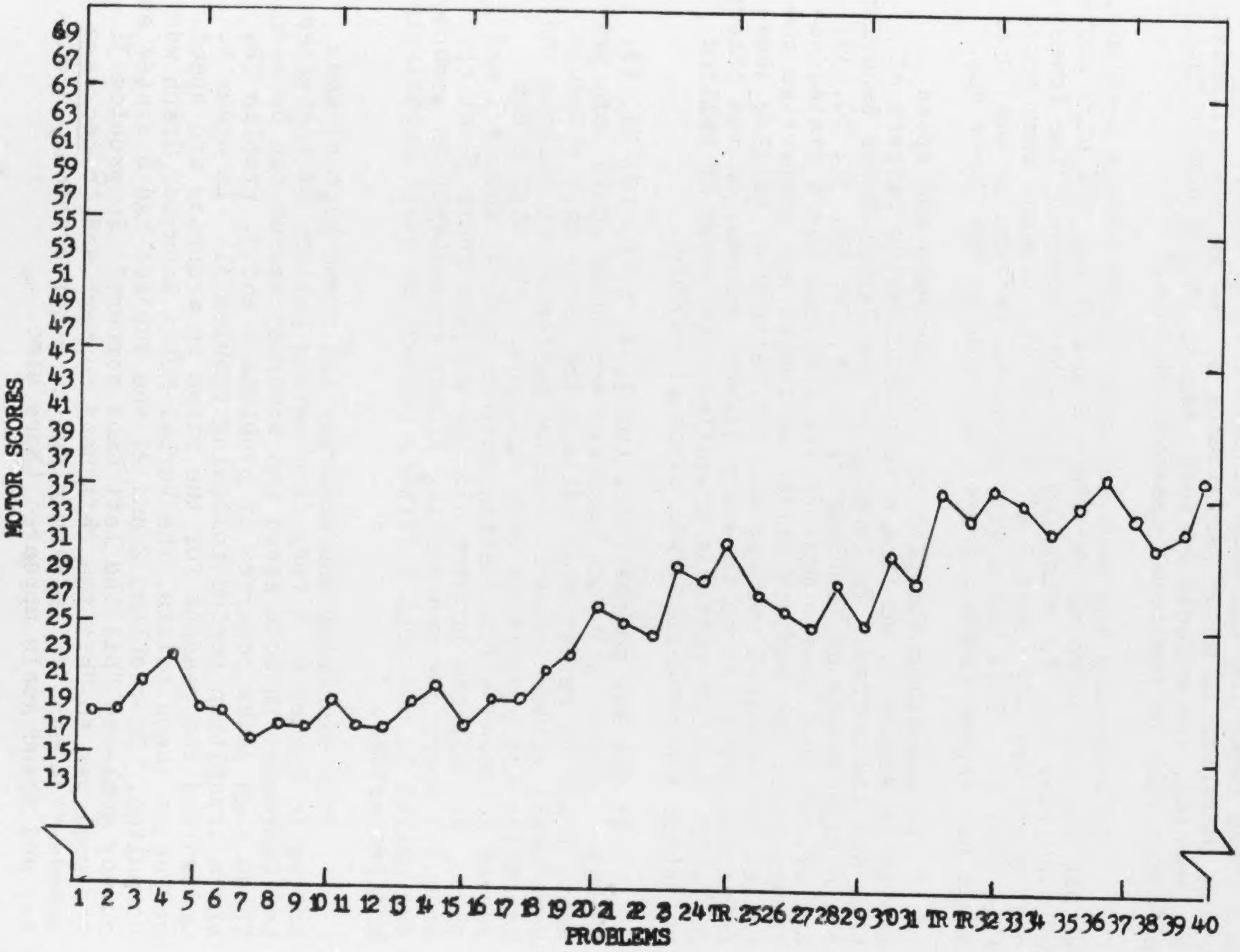

Figure 6.--Subject Two. Plot of mean motor performance scores by problems.

resulted in increases without rest (33.33%) followed by decreases without rest (27.77%), decreases with rest (13.88%), and those remaining the same without rest (13.88%). When using increases in motor performance scores as the criterion of learning, the effects of rest seem to play a rather insignificant role in the total learning picture.[1]

In examining the accuracy mean scores of the problems, we see the low score of .29 (days 2 and 4) and the high score of 2.20 (day 1). In examining the speed scores,[2] the lowest mean score was .29 (days 2 and 4) and the highest mean score 1.20 (day 1). This was a very atypical pattern in that one would not expect highest scores to occur on the first day.

In examining the plot of high accuracy and speed scores in Figure 7, we find a very fluctuating pattern of high and low scores. In looking at the Verbal-Motor Behavior Graph high scores at problems 2, 3, 15, 22, TR, 32, 36, 39, and 40, we find that: most of the problems had a stated accuracy goal; the subject called variables and properties and called and assigned values; the CRT pattern of calling these variables prevailed on the very highest scores; on the others, C, T, TR, and TCR patterns prevailed; the order of calling variables and properties was mixed or reverse.

At the low scores (problems 1, 4, 5, 6, 10, 14, 18, 28, TR after 31) both accuracy and speed goals were present; T and TR patterns of calling the three main subgoals were used; either forward or mixed patterns for calling the variables and properties were employed. The high speed scores followed a fluctuating pattern between scores 1 and 2 only. At only one problem did the subject score 3 (at episode 37) where she was working almost exclusively on accuracy; she called T, and used a forward pattern of calling variables and properties.

Upon examining the accuracy and speed plot of mean scores in Figure 8, a very fluctuating pattern of increases and decreases in both speed and accuracy scores can be seen. These high peaks occurred at problems 2 and 3, problem 22, and a transition period following problem 31. In order to understand the reasons for the rises in accuracy and speed scores at these points, the Verbal-Motor Behavior Graph was consulted. In problems 2 and 22 the subject had a stated accuracy goal--to "hit the left hand corner." In problem 31 the goal was to "hit the left hand corner" and to decrease speed--"too hard." In examining the other problems, accuracy and speed goals appeared there also.

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[1] See Appendix XXVIII.

[2] Ibid.

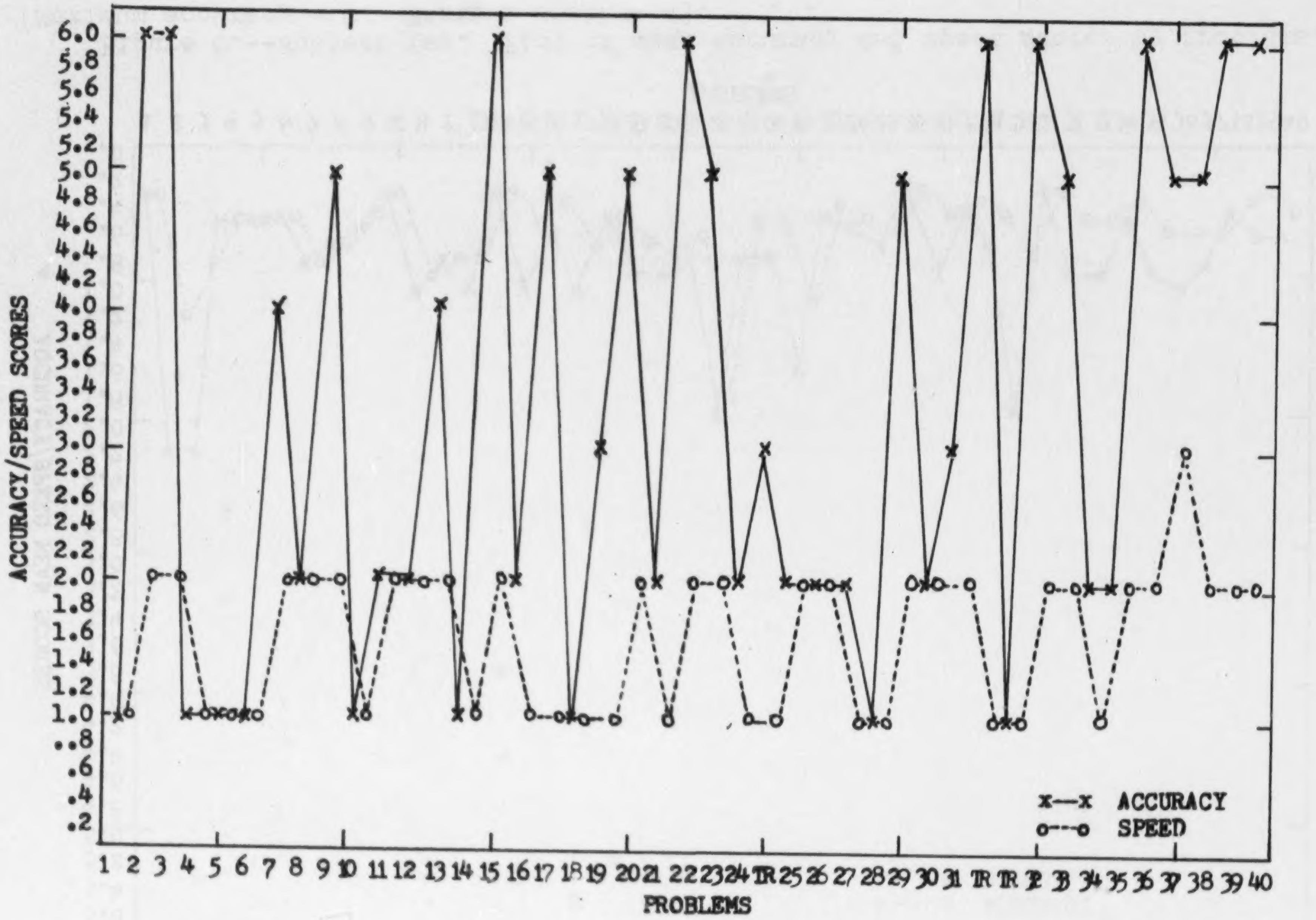

Figure 7.--Subject Two. Plot of high accuracy and speed sccres by problems.

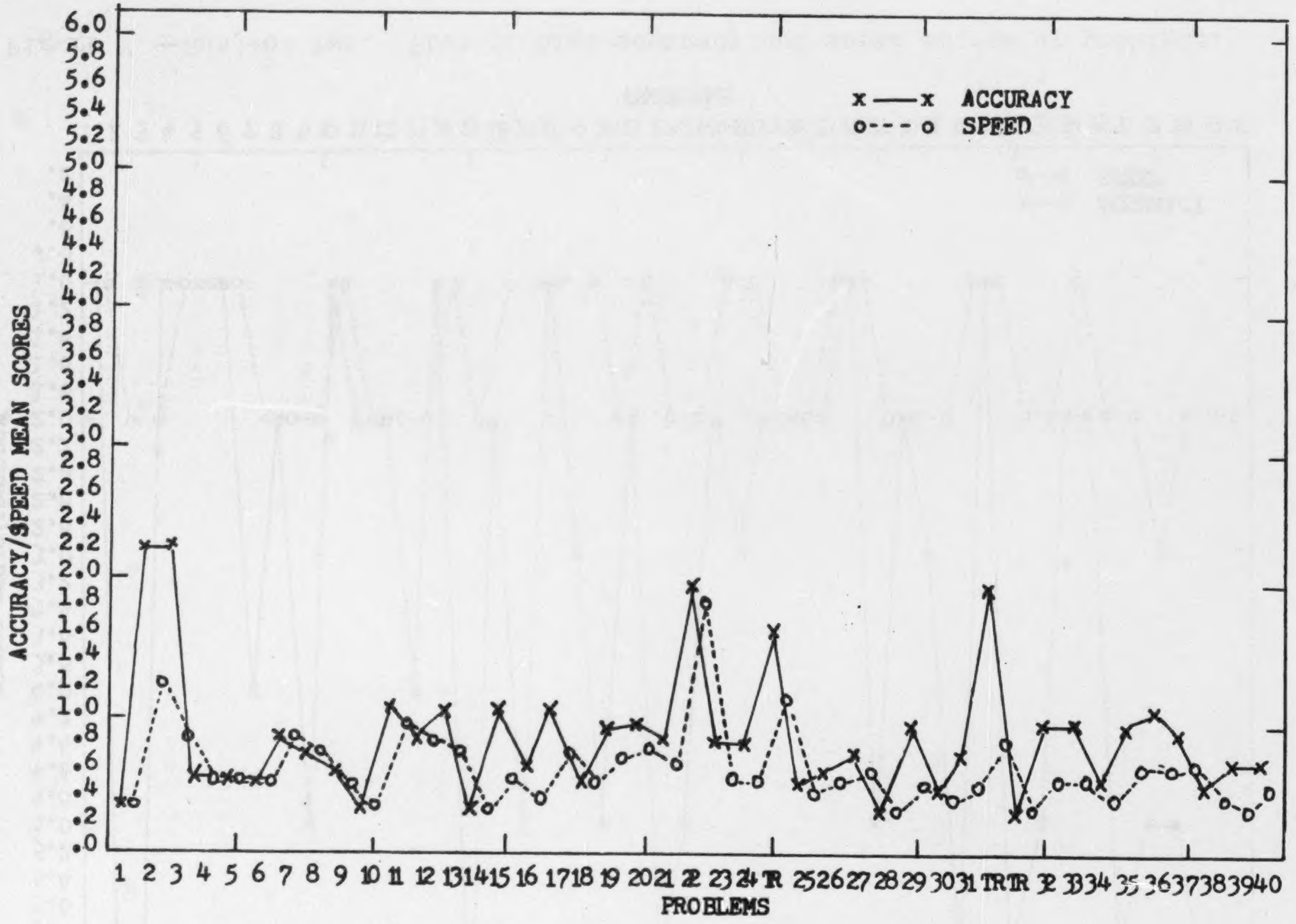

Figure 8.--Subject Two. Plot of mean accuracy and speed scores by problems. (Maximum accuracy = 6. Maximum speed = 4).

The following results can be seen upon examination of the increases and decreases between days in the accuracy and speed scores.[1] Among the accuracy scores we see 66.66% decreasing scores between days, 16.66% increasing scores and 16.66% remaining the same. This shows only a slight increase which could be attributed to reminiscence; the large percentage of decrease could be attributed to forgetting. The same percentages were true of the speed scores.

Concerning the increases and decreases within days in the accuracy and speed scores,[2] we see about an equal proportion of increases (25%) to decreases (27.77%). The scores remaining the same equalled 47.22% indicating that with this subject learning took place within the actual problems rather than between them within days. In analyzing the speed scores we see that 33.33% of the scores decreased, 19.44% increased, and 47.22% remained the same. This shows a greater possibility that a score would decrease or remain the same than increase between problems within days with this subject. One must look elsewhere than between problems for the reasons for high scores.

In examining the effects of rest upon the within-day increases and decreases of accuracy and speed scores,[3] increases in accuracy scores without rest occurred 11.11%, increases with rest 13.88%, decreases without rest 19.44%, decreases with rest 8.33%, scores remaining the same without rest 41.66%, and scores remaining the same with rest 5.55% of the time. There were more increases with rest than without rest. These five increases with rest could be attributed to reminiscence. When comparing the increases with rest to the decreases with rest, we see more increases (13.88% compared to 8.33%) again favoring the idea of reminiscence. The large number of scores that remained the same without rest indicates that the learning took place either because of or in spite of large number of scores remaining the same.

In examining the speed scores, we see that 11.11% increased without rest, 8.33% increased with rest, 25% decreased without rest, 8.33% decreased with rest, 36.11% of the scores remained the same without rest, and 11.11% remained the same with rest. There were more increases and decreases without rest than with it; however, total decreases exceeded total increases. In comparing increases with rest to decreases with rest, we see an equal percentage of both--8.33%. This seems to indicate an equal possibility that the initial score after rest would result in an increase or decrease--an increase due to the dissipation of fatigue factors as often as a decrease due to short term decay or other factors. Within the total picture the 8.33% increase that might be due to the dissipation of fatigue factors, however, was not great.

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[1] See Appendix XXIX. [2] Ibid. [3] See Appendix XXX.

Subject Three

Motor data. On the wallboard test the subject had a raw score of 25 which was in the 51 percentile (T-Score 50). From this predictive score one might expect that this subject would be average in motor skill in tennis. Her rank order on this test was 3 compared to the other subjects in this experiment. On the Hewitt serve accuracy test[1] her raw scores ranged from 2 (T-Score 48) on day 7 to 13 (T-Score 70) on day 3. This was rather atypical in that one would expect a beginner's scores to rise steadily. Her ranking compared to the other subjects was 4. On the Hewitt serve speed test[2] her scores ranged from 3 (T-Score 51) on days 5 and 7 to 7 (T-Score 63) on day 4. This was again an atypical pattern with high scores occurring prior to low scores. Her mean daily accuracy score[3] ranged from .52 on day 2 to 1.01 on day 3. Her ranking on this test was 4. Her mean daily speed scores[4] ranged from .30 on day 5 to .64 on day 4. Her rank order was 5. The subject's mean motor performance scores[5] ranged from 13 on day 1 to 44 on day 6. Her rank order was 6.

In considering the composite results on Subject Three's motor data, she was atypical in that most often high scores appeared on days prior to low scores except for the motor performance scores. Both high and low scores appeared mostly on days 3, 4, and 5. One low score appeared on day 7. Reasons for high scores not appearing on the last day could be attributed to weather, less practice, the result of watching her performance, or the pattern used in the analysis and solving of the problem. Her overall ranking was 5 on these tests. Her initial predictive score placed her number 3.

Verbal data.[6] The subject read in variables, properties and elements in the following order: serve feels comfortable, accuracy, grip, vertical position of the ball toss (T), arm (straight or curved), eyes on the ball, follow through, starting position of the body, horizontal position of ball toss (C), pendular continuous motion, timing, speed, motion (bat, hit, push, put (R)), contact on top of the ball, feet, whole body, wrist, concentration, arch, bent knees, racket heavier, contact off center, lean, practice, control, swing like a baseball, and reach.

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[1] See Appendix XXXI. [2] See Appendix XXXII. [3] Ibid.

[4] Ibid. [5] See Appendix XXXVI. [6] See Appendix XXXII.

She read in the main goals of accuracy, speed and form early. Two of the main properties of CRT, C and T, were read in early. R was read in in the middle of the program. Single variables and values were read in early followed by more complex elements; most of the complex elements were read in in the middle of the program. She dealt with variables, properties, and less complex elements at the end except "swing like a baseball" which is a complex concept. This pattern is similar to that of Subject One.

In analyzing the Verbal Motor Behavior Graph[1] as to agreements and disagreements with the GSPS model, the CRT variables were investigated first. She read in T first, followed by C, and did not investigate R as such. The order for this subject would be TC. She investigated the motion variable (batting, hitting, pushing, putting into the air). If motion is equated with position of the racket face (R) [R_1 = pushing (flat), R_2 = putting into the air (open), and R_3 = batting, hitting (closed)], then the order of reading in would be TCR. Patterns for problems with questionable or tentatively acceptable solutions were TR or TC. Patterns for problems with acceptable solutions were RT or CT. The three were never combined in one problem. There were only two rejected solutions, and the pattern employed was CT. For the positive problems the order of calling the properties and variables was reversed; for the negative problems, either forward or mixed; and for the questionable or tentative solutions, either forward or reversed. The order of call of the values of the C variable was: C_1, C_4, C_3, and C_5. The order of call for the T values was: T_1, T_2, T_3, and the order for the R variable was R_3, R_1, and R_2.

Combined verbal-motor analysis. In analyzing the verbal problems by the motor performance scores,[2] the range of scores went from 13 on day 1 to 44 on day 6. Upon examination of the plot of highest motor scores in Figure 9, we see a fluctuating but steadily rising pattern. In looking at the highest scores in more depth, we find that 26 cases occurred within the problems, and only two highest scores occurred between the problems. One of these two rises occurring between problems also occurred between days; the other occurred within a day without rest. Therefore, 27 problems of highest scores could be attributed to something other than reminis-

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[1] See Appendix XXXIV for the complete Verbal-Motor Behavior Graph and Appendix XXXV for a synopsis of the graph.

[2] See Appendix XXXVI for the complete analysis.

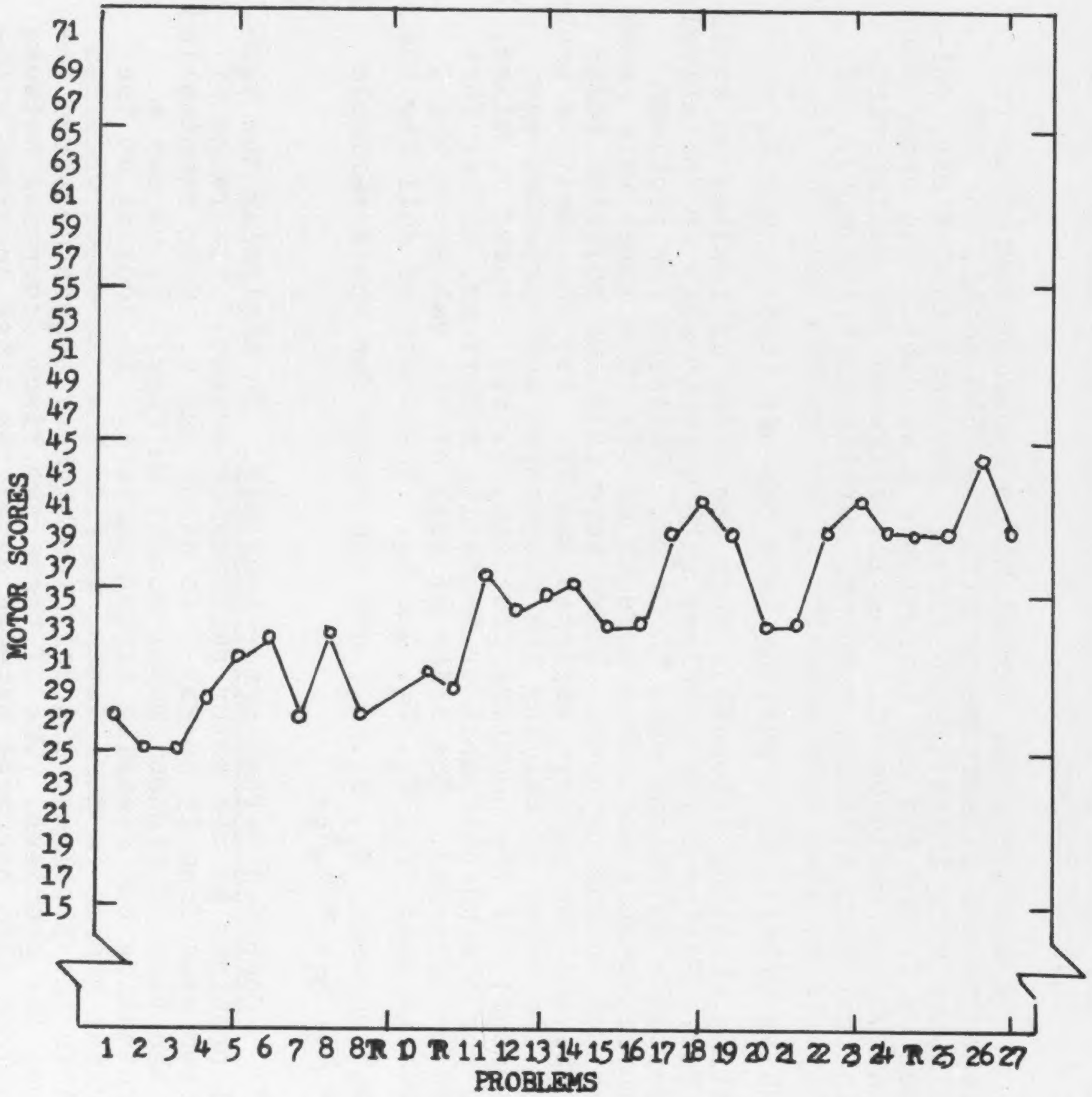

Figure 9.--Subject Three. Plot of high motor performance scores by problems.

cence and dissipation of fatigue factors. In order to further examine the reasons for these rises, an analysis of highest scores based on the verbal data was made.[1] In examining these high scores, the subject followed this pattern: she went from one variable to a combining of variables, assigning equivalences between variables, combining values and variables into larger properties, assigning values to variables, combining these into a variety of combinations, and narrowing the number of properties to the testing of a few large properties--speed, accuracy, vertical and horizontal positions of ball toss (T,C). At the very highest scores she was combining values and variables of properties singly or into larger elements.

Upon examination of the plot of the mean motor performance scores in Figure 10, we see a sudden rise, followed by a drop and then a steady but fluctuating rise until a transition period after problem 24 where the high score was made; the scores dropped again between problems 25-57. The subject read in the majority of variables (42) before problem 15, where we see a steady rise of scores. After that the subject read in only 12 variables during which time a levelling occurred and then the scores dropped. Problems 3-8 show a steady mean rise with predominantly tentative solutions. Most of day 1 shows a steady rise. The steady drop between problems 9 and 10 finds the subject introducing a new variable (arch) which resulted in problems of coordination and timing (elements) which she reorganized. She sought her solutions in other elements such as starting position, bent knees, and lean together with a large number of other variables read in and called. During the drop from TR, 25, 26, 27, she was primarily concerned with speed and accuracy; elements such as timing, comfort; adding together of properties; and she did not read in any new variables.

Upon examination of the between-day increases and decreases in motor performance scores,[2] there was 66.66% decrease and only 16.66% increase, indicating that very little learning could be directly attributed to the theory of reminiscence. Scores remaining the same amounted to 16.66%, which was equal to the percentage of increases.

In looking at the within-day increases and decreases in motor performance scores[3], there were nine increases (40.92%), eight decreases (36.66%), and five scores remained the same (22.72%) between problems. There appears to be

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[1] See Appendix XXXVII for the complete analysis.

[2] See Appendix XXXVIII for the complete analysis.

[3] Ibid.

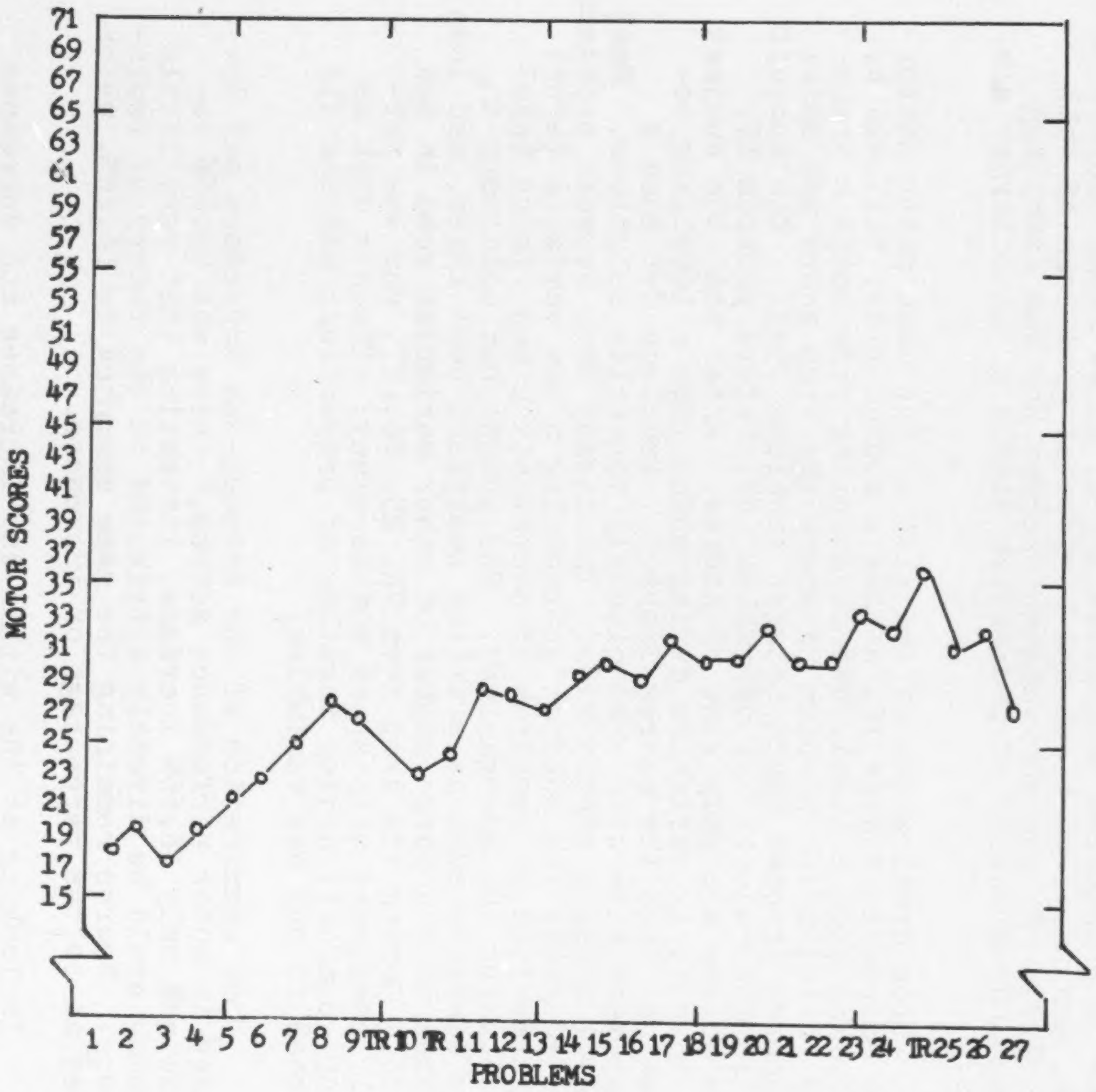

Figure 10.--Subject Three. Plot of mean motor performance scores by problems.

slightly more possibility that a score would increase than that it would decrease. In examining the effects of rest upon these scores,[1] a large number of both increases and decreases occurred during periods of no rest rather than with short rest periods. Approximately 60% of the scores resulted in either increases without rest or decreases without rest (27.27% increase; 31.81% decrease). This indicates that although the subject was allowed to rest as often as desired, she seldom rested, and when she did, there appeared to be a little less probability that the score on the serve following the rest would improve in motor performance than that it would not improve. Concerning the four rest periods, three resulted in increases and one in a decrease, indicating that in three out of 22 cases rises in scores could be attributed to dissipation of fatigue factors. The other increases between problems were due to other causes.

Upon examining the verbal problems by accuracy and speed mean scores,[2] the lowest mean accuracy score was .16 on day 2, and the highest score was 2.33 on day 4. The lowest mean speed score was .16 on day 2, and the highest was 1.33 on day 4. High scores were achieved by other subjects also on the fourth day. There could be a number of reasons for this: (1) the weather was windy and cold the last three days, (2) after the fourth day the subject read in very few variables; the problem became one of adding, subtracting, assigning values to the variables, testing, and assigning equivalencies rather than initially investigating new variables, which might be less motivating and which require more complex mental processes.

The plot of high accuracy and speed scores in Figure 11 reveals the following: few if any plateaus occurred except at the highest score and rises in accuracy scores followed two out of three transition periods. Since there were so many high scores, these scores would follow the general pattern of the total Verbal-Motor Behavior Graph. At the lowest accuracy scores (1, 7, 8, and 24) we see the following similarities: the solutions were mostly tentative; speed and accuracy goals both were present; there was much assigning of equivalencies and adding of variables, reading in and calling of variables and properties; T only was called to solve the problem, and both forward and reverse patterns were used in calling variables and properties.

In examining the plot of the highest speed scores in Figure 11, it can be seen that the high scores plateau at 2. The total pattern of the Verbal-Motor Behavior Graph would describe the high scores. At the highest score, 3.00 at

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[1] See Appendix XXXIX. [2] See Appendix XL.

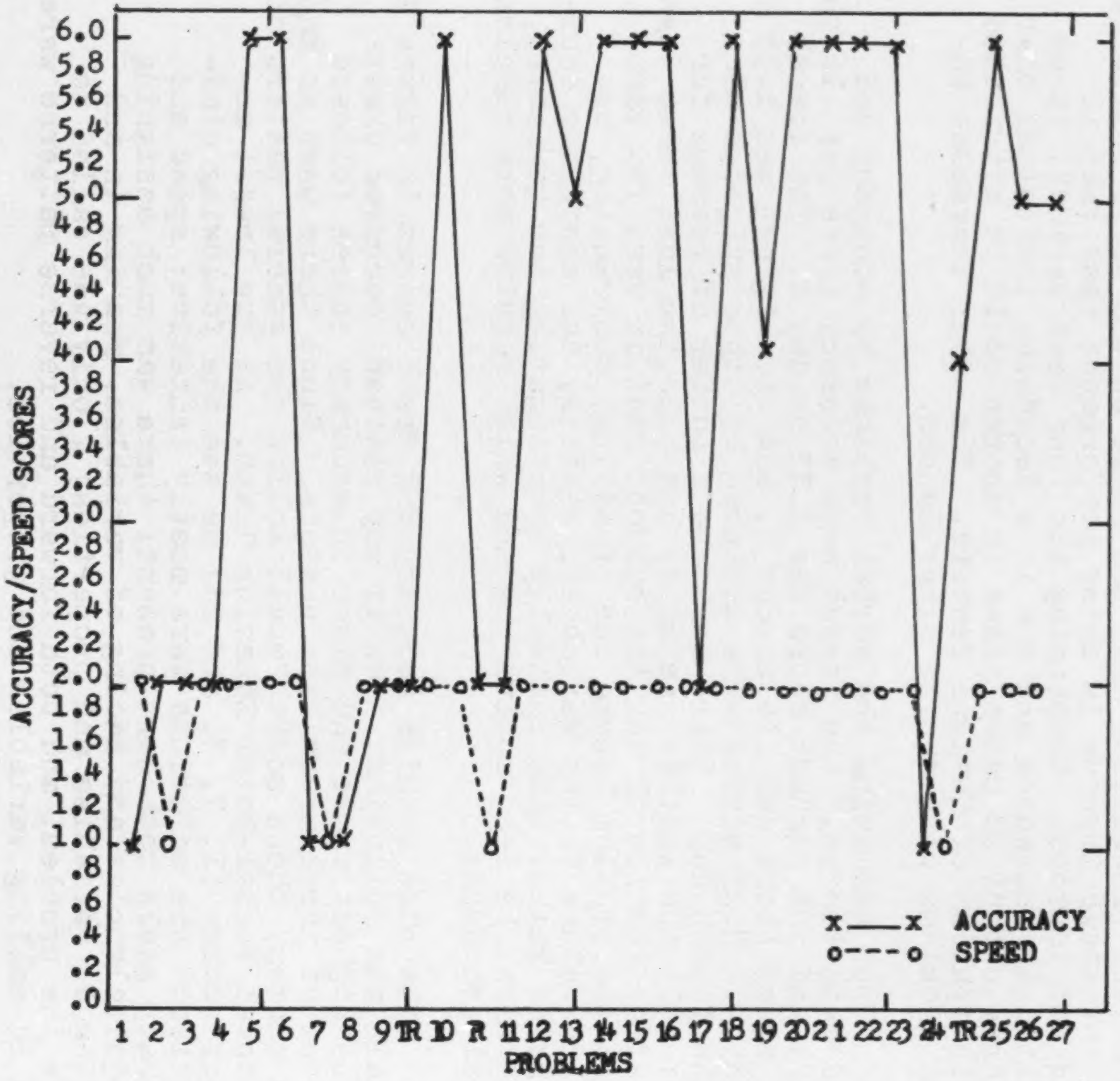

Figure 11.--Subject Three. Plot of high accuracy and speed scores by problems.

problem 27, the following pattern was employed by the subject: a tentative solution, accuracy and form goals, tested values of T, assigned equivalency and added variables (accuracy = T + C + eyes on the ball), called three properties, assigned two values, employed TC, and called properties with the reverse pattern.

In examining the accuracy speed plot of mean scores in Figure 12, we see a rather strange pattern of extreme rises in the accuracy scores within a very fluctuating pattern of scores. In referring to the Verbal-Motor Behavior Graph to see what occurred at these high rises in accuracy at problems 5, 12, and 20, we see that during problem five the subject was pursuing the possibilities of batting, hitting, pushing or putting the ball into the air (R). She did not have a stated goal of accuracy. During problem 12 she was again attacking the possibilities of batting the ball or pounding it into the ground with stated goals of speed and accuracy. She was also working on various positions of vertical ball toss while expressing confusion in goal. If she tossed high, she had a better reach but less accuracy; if she tossed lower, she had more accuracy but less speed. These goals do not seem to be vastly different from the goals of the neighboring problems. Goals of accuracy and speed predominated throughout the entire program, although there might be more positive attacks on accuracy and speed here. Examining the low scores at problems 7 and 23, we find that the subject was working on the problem of tossing the ball high and reaching for it with the result of a decrease in accuracy or tossing it lower, hitting with a sidearm, with less speed but more accuracy. This was the same problem she was trying to solve in problem 12--a high scoring problem. She rejected the high toss in problems 7 and 23 because of the poor speed results.

The following results can be seen when examining the increases and decreases between days in accuracy and speed scores with and without rest.[1] Of the six possible increases or decreases in accuracy, only one increase and two decreases occurred. The 16.66% increase could be attributed to reminiscence. The fact that two cases resulted in decreases and three remained the same shows that little learning as evidenced in motor performance scores of this subject could be attributed to this factor. In looking at the speed scores, two cases increased, one case decreased, and three remained the same. Two in six cases or 33.33% of the cases could be attributed to reminiscence.

Increases and decreases within days in accuracy and

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[1] See Appendix XLI for the complete analysis.

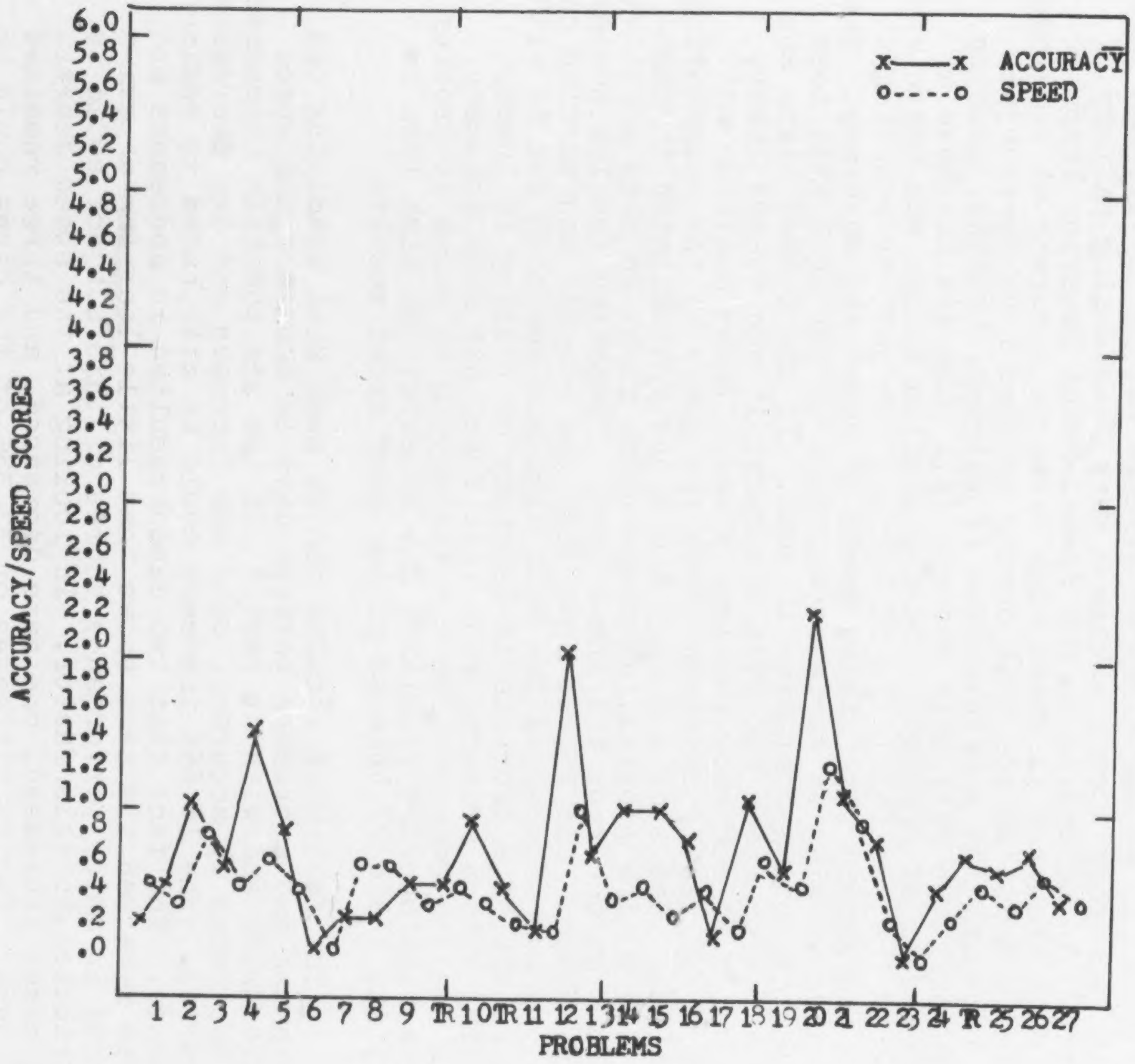

Figure 12.--Subject Three. Plot of mean accuracy and speed scores by problems.

speed scores[1] were about equal (accuracy = 21.73% increase, 17.39% decrease; speed scores resulted in 13.04% increase and 17.39% decrease). This indicates that there was about an equal probability that a score would increase or decrease with this subject. A large percentage of scores remained the same (58.62%).

In studying the effects of rest upon the increases and decreases of accuracy and speed scores,[2] we find that with the accuracy scores there was 17.39% increase without rest to 4.34% increase with rest; 17.04% decrease without rest to 4.34% decrease with rest; 30.43% of the scores remained the same both with and without rest. In looking at the speed scores, we see 13.04% increased without rest, 6% increased with rest; 17.39% decreased without rest; 0.00% decreased with rest; 47.82% of the scores remained the same without rest and 31.25% stayed the same with rest. There were no increases or decreases with rest, indicating that reminiscence could not be a factor contributing to the learning with this subject. More scores remained the same than either increased or decreased. Rests did not appear to be a significant factor in increases in accuracy and speed scores. As with the motor performance scores, most increases occurred within the problems.

Subject Four

Motor data. On the wallboard test the subject had a raw score of 28 which was in the 70th percentile and had a T-Score of 54. From this initial predictive score, it would be expected that this subject would perform better than average. Her rank order on this test compared to the other subjects in this experiment was 1. On the Hewitt serve accuracy test,[3] her scores ranged from 6 (T-Score 58) on day 6 to 18 (T-Score over 80) on day 4. This was rather an atypical pattern with a high scoring day preceding a low scoring day. Her scores did not follow a pattern of daily fluctuation which might have been an explanation; but a pattern of high, low, high, high, low, low, high. Her rank order on this test was 2. On the Hewitt serve speed test[4] her scores ranged from 3 (T-Score 51) on days 2 and 6 to 12 (T-Score 75) on day 4. This again was an atypical pattern. Her ranking on this test was 3. Her mean daily accuracy score[5] went from .30 on day 1 to 1.93 on day 7, a typical pattern. Her ranking was 1. Her mean daily speed scores[6] ranged from .23 on day 1 to 1.00 on day 7;

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[1] See Appendix XLII for the complete analysis. [2] Ibid.

[3] See Appendix XLIII for the complete analysis.

[4] See Appendix XLIV for the complete analysis.

[5] Ibid. [6] Ibid.

a typical pattern. Her ranking was 2. On the mean motor performance scores[1] her scores ranged from 41.20 on day 1 to 52.64 on day 1, problem 1. Her rank order was 1. Her lowest and highest mean scores appeared on day 1 and her highest mean score occurred in the first problem, a very strange occurrence.

In examining the composite results on the motor data for Subject Four, we see that she scored the highest on the initial placement test and she ranked first on the total rank order on all tests. Her high scores on accuracy and speed were atypical--highest scoring days occurred before lowest scoring days. Her motor performance scores followed a typical pattern--low scores on the first day, high scores on the last. One wonders why high accuracy and speed scores occurred on the first day and form scores on the last.

Verbal data. The order the subject read in variables, properties and elements[2] was: vertical position of ball toss (T), reach, arch, smash, wrist (horizontal), racket brought down, accuracy, racket brought up, grip, lift, whole body, horizontal position of ball toss (C), lean, relax, speed, angle, top, backswing, forward swing, feet still, on toes, contact on top of the ball, timing, sway, position of racket face (R), feel of it, follow through, thinking, thumb in, contact on center of the racket, elbow up, hitting down off arm, waiting position, wind, body position, control of the racket, and natural, smooth stroke--whole stroke. She read in the main goals accuracy and speed and also the main properties early. R was read in about midway in the program; (this pattern was used by Subjects One and Three also). Single variables and larger elements were read in about equally throughout the program. There were more complex elements later in the program than earlier.

In analyzing the Verbal-Motor Behavior Graph[3] as to agreements and disagreements with the GSPS model, the CRT variables were investigated first. The subject read in these variables in the following order: TCR. The T and C variables were the most prevalent and occurred together most frequently for both accepted and rejected problems. The predominant pattern for acceptable solutions was TCR but for unacceptable solutions it was CTR.

The pattern for reading in variables was mixed in positive, negative and tentatively acceptable solutions. If the mixed pattern is not considered, the forward pattern predominated for the negative solutions and the reverse pattern predominated slightly for the positive solutions. In the mixed pattern we see the following type of pattern: forward, jump back to early variable, forward, jump back, forward, etc. So actually, a forward-backtracking pattern prevailed. This pattern was true for reverse-mixed patterns also. However, no particular pattern was consistently present. This subject was a negative strategy learner--25 negative solutions to three tentative solutions and 11 positive solutions. The order of reading in the C variables was C_1, C_5, C_2, C_4; the T variables was: T_2, T_3, T_1, and the R variables: R_1 and R_{Twist} (unique to this subject).

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[1] See Appendix XLVIII for the complete analysis.

[2] See Appendix XLV for the complete analysis.

[3] See Appendix XLVI for the complete Verbal Motor Behavior Graph and Appendix XLVII for a synopsis of the graph.

Combined verbal/motor analysis. In analyzing the verbal problems by the motor performance scores,[1] the range of scores was 31 on day 5 to 63 on days 2, 3, 4, and 5. Upon examination of the plot of highest motor scores in Figure 13, we see that there was a high fluctuation between low and high scores at the beginning, a levelling off, another high rise, a low score, a levelling off and more fluctuation between high and low scores. In looking at the highest scores only, all 32 cases occurred within problems, none between. Since no rests occurred here, in no cases could highest scores be attributed to reminiscence or dissipation of fatigue factors. In order to further examine the reasons for these rises, reference was made to the Verbal Motor Behavior Graph.[2] In examining these high scores, we see this pattern: she went from examination of a few variables, to reading in, assigning values to a large variety of single variables, to combining them singly, to combining them into larger elements, assigning equivalency, putting them into a larger element called "everything together" at the end of the program. She worked with positive goals and used both negative and positive evaluations. At the very highest scoring episodes, she combined values, variables and properties into larger combinations of single variables or into larger elements or subgoals or assigned equivalencies.

Upon examination of the plot of the mean motor scores in Figure 14, we see a much different type graph than with the previous subjects. She began with much higher mean scores than the others and her scores had a narrow range--41-53. Small fluctuations occurred at the beginning, levelling off in the middle, a drop at problem 24, rise at

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[1] See Appendix XLVIII for the complete analysis.

[2] See Appendix XLVI for the complete analysis.

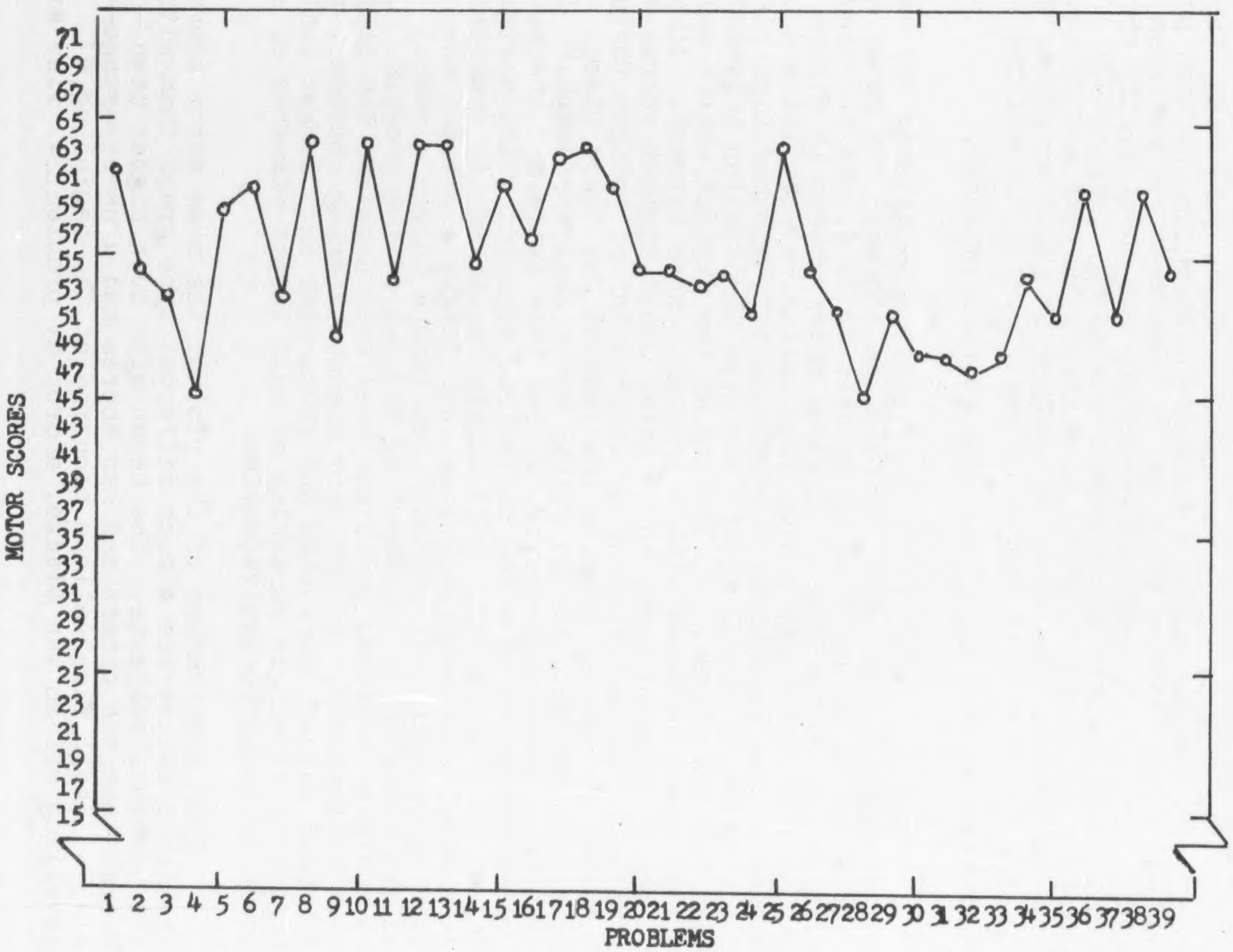

Figure 13.--Subject Four. Plot of high motor performance scores by problems.

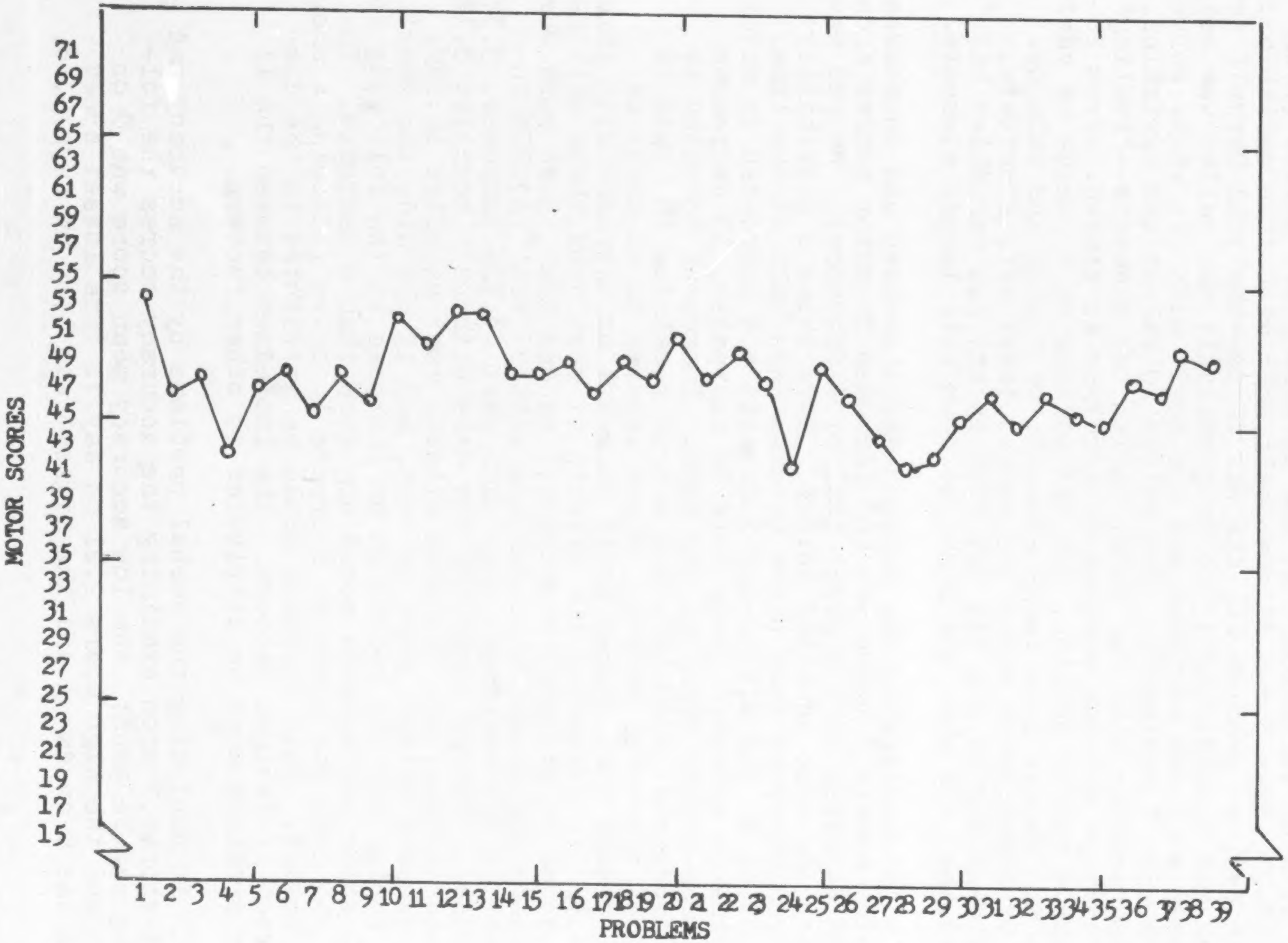

Figure 14.--Subject Four. Plot of mean motor performance scores by problems.

25 followed by more fluctuating scores. From the Verbal-Motor Behavior Graph we see that at the beginning, during the fluctuating scores, the subject read in, assigned values, and dealt with 42 variables. At the levelling off period (problems 13-23, days 3 and 4) she dealt only with five variables. At the drop at problem 24, she was tense--she told herself to "relax and concentrate"; the only variable she called was grip, her main goal was accuracy and she dealt with the whole serve. At the rise (problem 25), she called 10 values and variables, denoted problem with the wind, called two elements--"feeling" and "timing" and was working on accuracy as stated. From 26-28, where scores decline, she was working on a number of variables and values plus large elements of timing and balance. From problems 30-38 where the scores level off, fluctuate, but rise slightly she did not read in any new variables but called many old ones and combined them into larger elements.

In considering the between-day increases and decreases in motor scores,[1] there was 50% increase in motor scores and 33.33% decrease (not a great deal of difference). Scores remaining the same equalled 16.66%. This shows a possibility that reminiscence took place between days half of the time. In looking at the within-day increases and decreases in motor performance scores,[1] there were 16 increases, 13 decreases, and three scores remained the same. Increases amounted to 50%, decreases to 40.62%, and scores remaining the same to 9.32% of the total scores. There appears to be about an equal chance that scores would increase or decrease with this subject. In examining the effects of rest upon these within-day scores on accuracy and speed,[3] we see that there were more increases and decreases occurring without rest (43.75% increase, 34.37% decrease) than with rest (3.72% increase, 9.37% decrease). Scores remaining the same with rest equalled 3.12% and scores remaining the same without rest equalled 16.25%. This subject seldom chose to rest, and if she did, the short rest period did not result in an increase in the following initial motor performance score any more than a decrease. In only one case was there an increase in score following a short rest period. This increase could be attributed to the dissipation of fatigue factors. The increases between the 14 other problems must be attributed to other factors.

In analyzing the verbal problems by the accuracy and speed scores,[4] upon examining the accuracy scores the following can be seen: the low accuracy mean score was 0 on day 1 and the high score 2.21 on day 7. The lowest speed score was 0 on day 1 and the highest was 1.14 on days 5, 6, and 7. This subject followed what would be a typical pattern with low scores on day 1 and high scores on day 7. In examining the plot of high accuracy and speed scores in Figure 15, two extremely low scores occurred at problems 3 and 4. At these low scores the subject came either to a tentative solution or to an acceptable solution, and goals of speed and accuracy were present. She read in two properties, called four properties, assigned four values, used CT only, and used a reverse pattern of call. At the highest scores (7, 8, 11, 15, 16, 17, 21, 29, 36, 38, and 39) the subject did the following: she employed accuracy and speed goals, called properties, assigned values, used TCR or RCT to solve the problem, and used a variety of pattern in calling variables. At the one plateau (22-28) we see the following: the subject worked on the accuracy goal, on the elements timing and form; called variables; assigned values; used R or RC in solving the problem, and used a mixed pattern of call. In examining the plot of highest speed scores, the subject levelled off at two. The general plan of the total Verbal- Motor Behavior Graph describes the pattern of the highest speed scores. The low scores at three and four coincided with the low accuracy scores above.

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[1] See Appendix L. [2] Ibid. [3] See Appendix LI.

[4] See Appendix LIII for the complete analysis.

In examining the plot of mean accuracy and speed scores in Figure 16, we see a very fluctuating pattern of accuracy scores. The speed scores also followed a fluctuating pattern, but the scores were not as high. There were no plateaus. In referring to the Verbal-Motor Behavior Graph at problems 18 and 33 where the low scores occurred, we see that at 18 the subject was examining the whole serve; working on "timing" and "feeling" elements; reading in a new variable (H); calling nine variables, four values; reading in variables in a forward pattern; and rejecting the solution. In problem 33 she was working on accuracy, calling three variables in reverse, and rejecting the solution. The only thing in common between these is that she rejected both solutions and was working on hitting down.

Upon examination of the increases and decreases between days in accuracy and speed scores,[1] we see that there were no increases in score, one decrease, and five scores remaining the same in accuracy; and no increases between days, no decreases, and six scores remaining the same in speed scores. This no percentage of increase or decrease in either score indicates that no increase could be attributed to reminiscence or to forgetting.

In looking at the increases and decreases within days in the accuracy and speed scores,[2] there were approximately

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[1] See Appendix LIII. [2] Ibid.

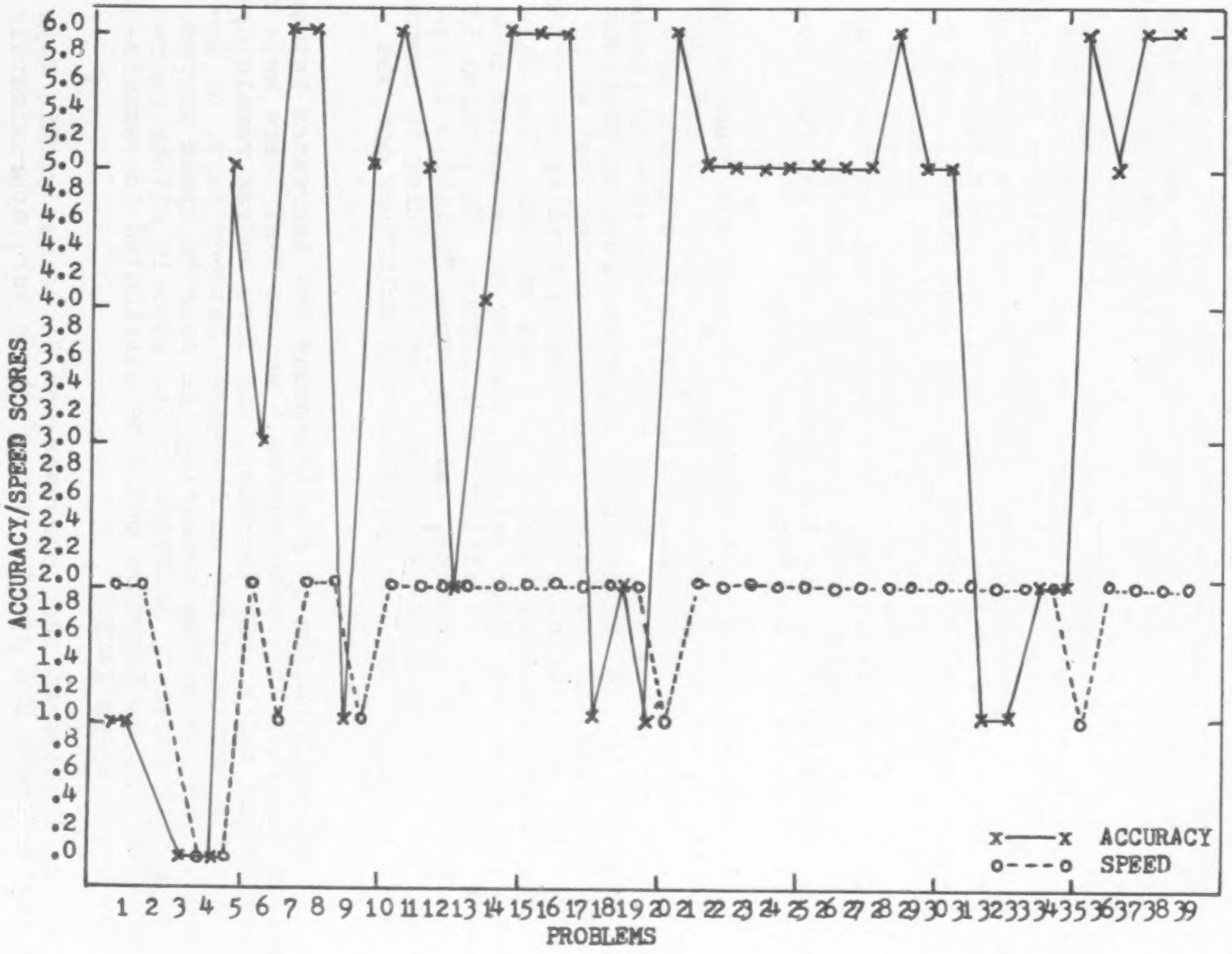

Figure 15.--Subject Four. Plot of high accuracy and speed scores by problems.

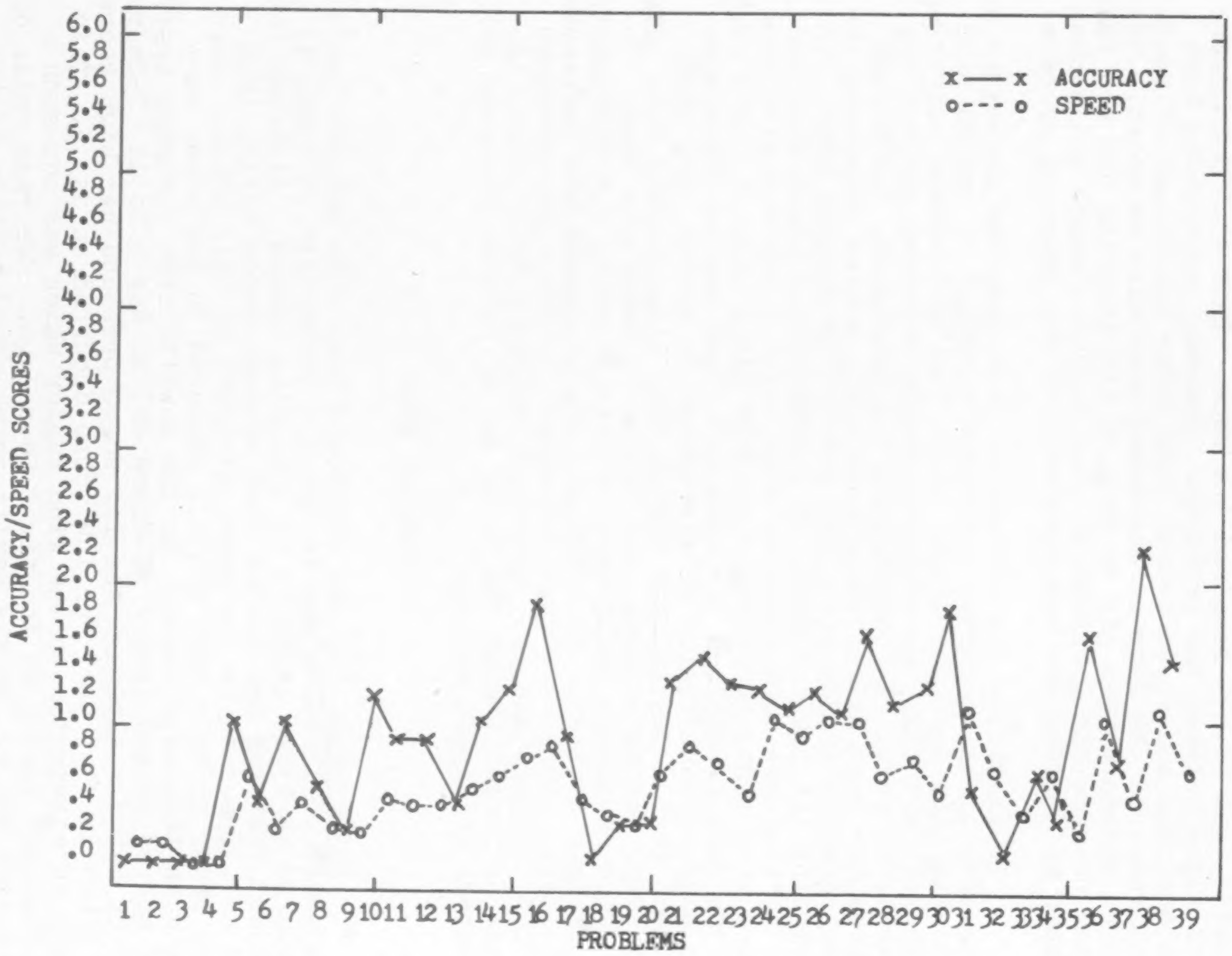

Figure 16.--Subject Four. Plot of mean accuracy and speed scores by problems. (Maximum accuracy = 6. Maximum speed = 4).

four times as many increases as decreases in the accuracy scores. The percentage of increases was 46.87%, decreases was 12.5%, and 40.62% remained the same. In looking at the speed scores within days, we see 43.75% increased, 9.37% decreased, and 46.87% remained the same. This 43.75% increase took place between the problems. However, concerning both the accuracy and speed scores, the large percentage of scores that remained the same or decreased must also be noted. These scores indicate that either much of the learning did not take place between the problems or that both increases and scores remaining the same and are essential to the learning process.

In examining the effects of rest upon the increases and decreases of the accuracy and speed scores,[1] it can be seen that with the accuracy scores there was 0% increase occurring with rest and that the 46.87% increase occurred without the benefit of rest. In considering the decreases, 3.12% took place with rest and 9.37% without rest; scores remaining the same equalled 12.50% with rest and 28.12% without rest. In examining the speed scores, 0% increase took place with rest, 43.75% increase took place without rest; 3.12% decrease took place with rest, 6.25% decrease took place without rest; 12.5% of the scores remained the same with rest and 34.37% stayed the same without rest. All increases in scores took place without rest. The subject rested very little--only four times, and after the four rests, her scores remained the same. No increase in scores could then be attributed to the dissipation of fatigue factors. In comparing the increases and decreases with rest, there were more decreases (3.12%) than increases (0.00%) in both accuracy and speed scores without rest, indicating forgetting as the prime factor between problems in accuracy and speed scores.

Subject Five

Motor data. On the wallboard test this subject had a raw score of 12 which was in the 7th percentile (T-Score 4) compared to other students of beginning tennis. Although the subject felt she had better than average motor skill, this did not appear to be the case, at least on this skill. Her rank order on this test was six compared to the other subjects in this experiment. On the Hewitt serve accuracy test[1] her scores ranged from 2 (T-Score 48) on day 5 to 11 (T-Score 67) on day 7. Although her low score preceded her high score, it seems unusual that her low score occurred on day 5. This might be attributed to the wind factor which was not such a predominant factor on the first four days. Her rank order on this test was 6. On the Hewitt serve speed portion of the test[2] her scores ranged from 2 (T-Score 46) on days 4 and 5, to 7 (T-Score 63) on day 7. The low score on day 4 could not be attributed to the wind although it could on day 5. Her rank order was 6. Her mean daily accuracy score[1] went from .24 on day 4 to .95 on day 1. This was a very atypical pattern as one would expect the high score to be on the last day rather than on the first. Her ranking on this test was 6. Her mean daily speed scores[2] ranged from .19 on day 4 to .63 on day 1, again a very atypical pattern. Her rank order on this test was 6. The mean motor performance score[3] went from 12 on day 1 to 58 on day 4. Her rank order was 3. The high score on day 4 with low scores on days 5, 6, and 7 might be attributed to weather conditions.

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[1] See Appendix LIV. [2] See Appendix LV. [2] Ibid.

In considering her composite results on the motor tests, she ranked the lowest in both initial placement test and on the composite score. The only score which was not last was her motor performance score. Her high scores followed her low scores on all tests; her high testing scores occurred on day 7 and her high mean scores were found on day 4, which is an interesting result. Did she give an all-out effort that motivated her to achieve on the last test in spite of her average performance?

Verbal data. The order the subject read in variables, properties and elements[4] was: speed, contact on center, accuracy, vertical position of ball toss (T), arm (move less), wrist (horizontal position), nervousness (relaxation), grip (tighter), concentration, control, timing, arm (elbow positions), movement on the court, angle, horizontal position of ball toss (C), grip (type), starting position, reach, form--feeling, exchange of rackets, spin, arch, step back, lean, follow through, racket brought up, position of racket face (R), momentum, foot position, movement of whole body, coordination, wrist (snapped), wind, balance, faster movement (timing), finger on the racket, and backswing. She read in variables and values quickly--33 on days one and two. On the other five days she read in a total of 28 variables. She read in the main goals of accuracy and speed early and also the CT variables. The R variable was introduced late in the program. (This CT-R pattern was followed by Subjects One, Three, and Four also). She read in a mixture of variables, properties and elements. The longer, more complex elements were scattered throughout the program rather than more of them being introduced at the middle or end.

In analyzing the Verbal-Motor Behavior Graph[5] as to agreements and disagreements with the GSPS model, the CRT variables were investigated first. The subject read in these variables in the following order: TCR. T and C predominated in all solutions whether they were negative, positive, or tentatively accepted. T predominated in all early problems. R did not appear until episode 21. The reverse pattern for reading in variables predominated in problems with acceptable and negative solutions. Mixed patterns, followed by reverse patterns, occurred most frequently in tentatively accepted solutions. A positive-type learning strategy prevailed throughout the first part of the program with such positive reinforcements as "I like my serve" or "My serve is pleasing to me." Later the subject showed more insecurity or questioning. On the last day, after watching herself on the television monitor, she said nothing. The order of calling the C variable was: C_1, C_4, C_2, C_{Left} (unique to S.), C_3; the order of reading in the T variables was: T_1, T_3, T_2. (It is difficult to distinguish between T_1 and T_3 in the verbal protocol.) R was considered in two problems only, and the consideration of R occurred when considering the arm-elbow position.

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[1] See Appendix LVI. [2] See Appendix LV.

[3] See Appendix LX. [4] See Appendix LVII.

[5] See Appendix LVIII for the complete Verbal-Motor Behavior Graph and Appendix LIX for the synopsis of the graph.

Combined verbal/motor analysis. In analyzing the verbal problems by the motor performance scores,[1] the range of scores went from 12 (day 1) to 58 (day 4). Upon examination of the plot of highest motor scores in Figure 17, we see that there was a fluctuation between high and low scores from the transition period following problem 29 until problem 33 when we see a drop followed by a rise and another drop. In further examining these high scores, we see that 41 rises occurred within problems and 2 between. In all cases including the two high scores between problems, rises occurred without rest. Learning as indicated by high performance scores took place within the problems themselves except for two cases, indicating that highest scores of this subject cannot be attributed to reminiscence or the dissipation of fatigue factors. In order to further examine the reasons for these rises, an analysis of highest scores based on the verbal data was made.[2] In examining these high scores only, we see that on each of these scores the subject was assigning values to variables, testing one positive goal, assigning equivalences, and combining single variables. At the lowest points (4 and 14), she was working on decreasing speed (not form). At problem 28, the highest scoring problem, she was working on accuracy assigning equivalencies, and combining variables (accuracy = angle + spin + hit down). At the plateau of high scores (TR-33) she was working on a larger element--coordination; introducing two new properties--lean and body position; assigning equivalencies (coordination=lean + body position);

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[1] See Appendix LX. [2] See Appendix LXI.

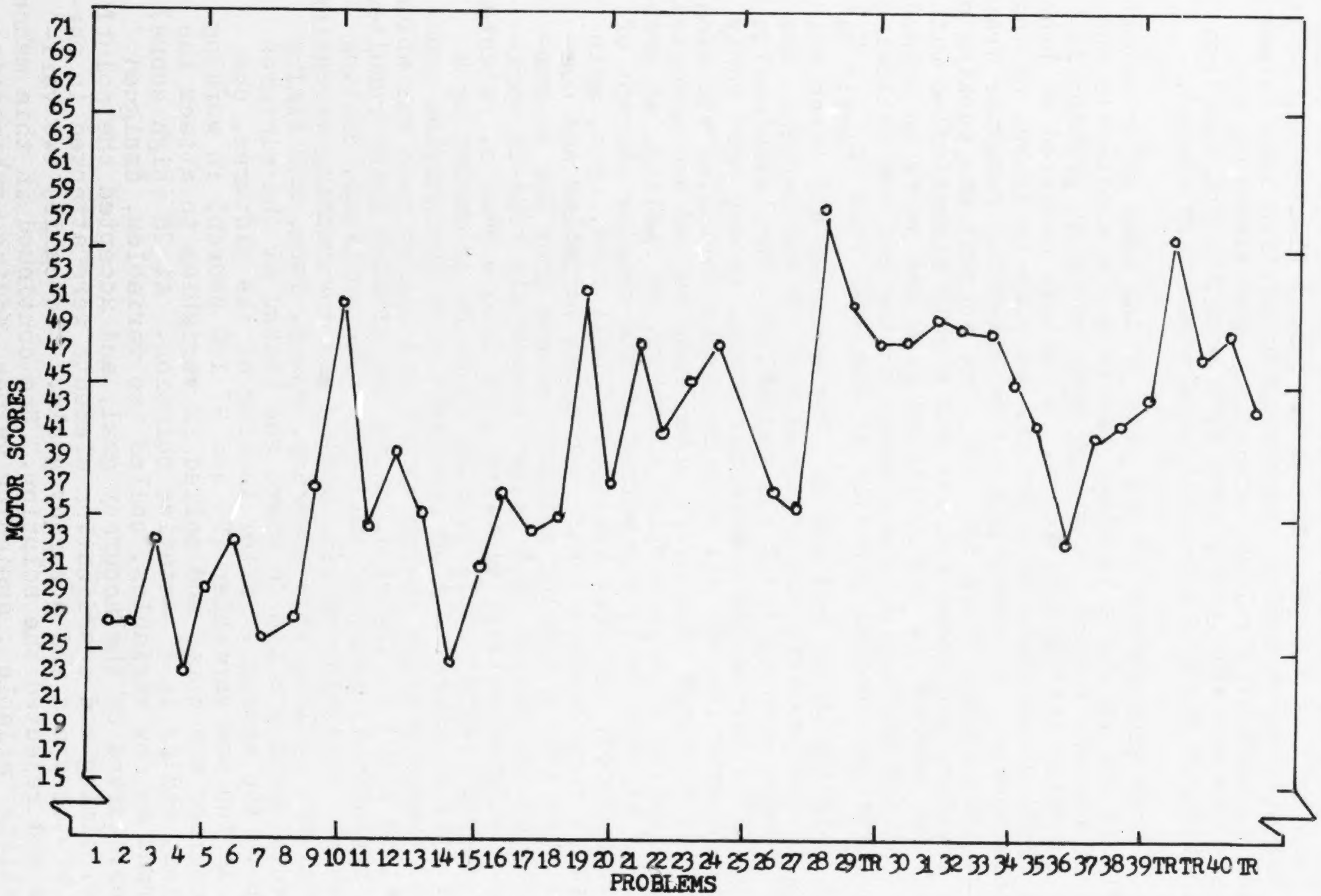

Figure 17.--Subject Five. Plot of high mctor performance scores by problems.

testing and combining variables (body position + angle + T + lean). She started with a transition period with no comments. The last half of the program was marked by fluctuating scores; she was testing variables, combining properties into larger elements, assigning values, assigning equivalencies, and testing one variable. She used both positive and negative evaluations. Most of her goals were positively stated.

Upon examination of the plot of the mean motor scores in Figure 18, we see a pattern that is quite similar to the plot of highest scores. The high mean score at problem 19 also contains the highest score. A plateau occurred at problems 22-24 where there is a pronounced rise in score, on the highest scores. In examining the Verbal-Motor Behavior Graph we see that during these problems, the subject was working on both accuracy and speed and she was highly dissatisfied with both. She stated she was satisfied with the serve in episode 23. She was working on the element timing and the following variables: horizontal position of the ball toss (C_{left}, C_4), reach, tighten grip, and angle. She accepted all three solutions to the problems but rejected most of the serves. She used reverse reading in of the variables. Upon examination of the total Verbal-Motor Behavior Graph, we see that early in the program the subject read in single variables and single elements, assigned values, rejected some values and accepted others, called in more complex elements, as feeling, at problem 13. At problem 17 she worked on the complex concept of accuracy-speed, vertical position of ball toss, spin, grip and wrist snap combinations. She added variables and combined them into a complex pattern (scores drop due to complexity of the task). She called previously read-in variables, assigned values, combined them into elements, rejected and accepted values until problem 20 which is marked by a large rise in score. At 20 she dealt with the complex problem of changing grips (score drops) and called nine variables (combined them) in trying to solve the problem which resulted in a tentatively accepted solution. She continued calling variables, assigning values, adding and subtracting variables and values, dealing with accuracy, speed, form, and timing elements until problem 26 where she looked at the pictures (drop in the scores). After looking at the pictures, she read in two new variables (26 and 27 low scores) in working on accuracy and speed and called 12 variables to attack the problem, ending in a tentative solution. At 28 (high score) she read in new variables, called two variables, assigned values, worked on the accuracy goal, and accepted the solution. At 29, timing and coordination elements were attacked in pursuit of the speed and accuracy goals. She called two variables and rejected the solution. She continued in this manner of calling variables, assigning values, adding, subtracting values and variables, working on coordination, timing, and form elements in attacking the main problem of accuracy and speed. She called fewer variables from problem 39 until the end (almost entirely without comment).

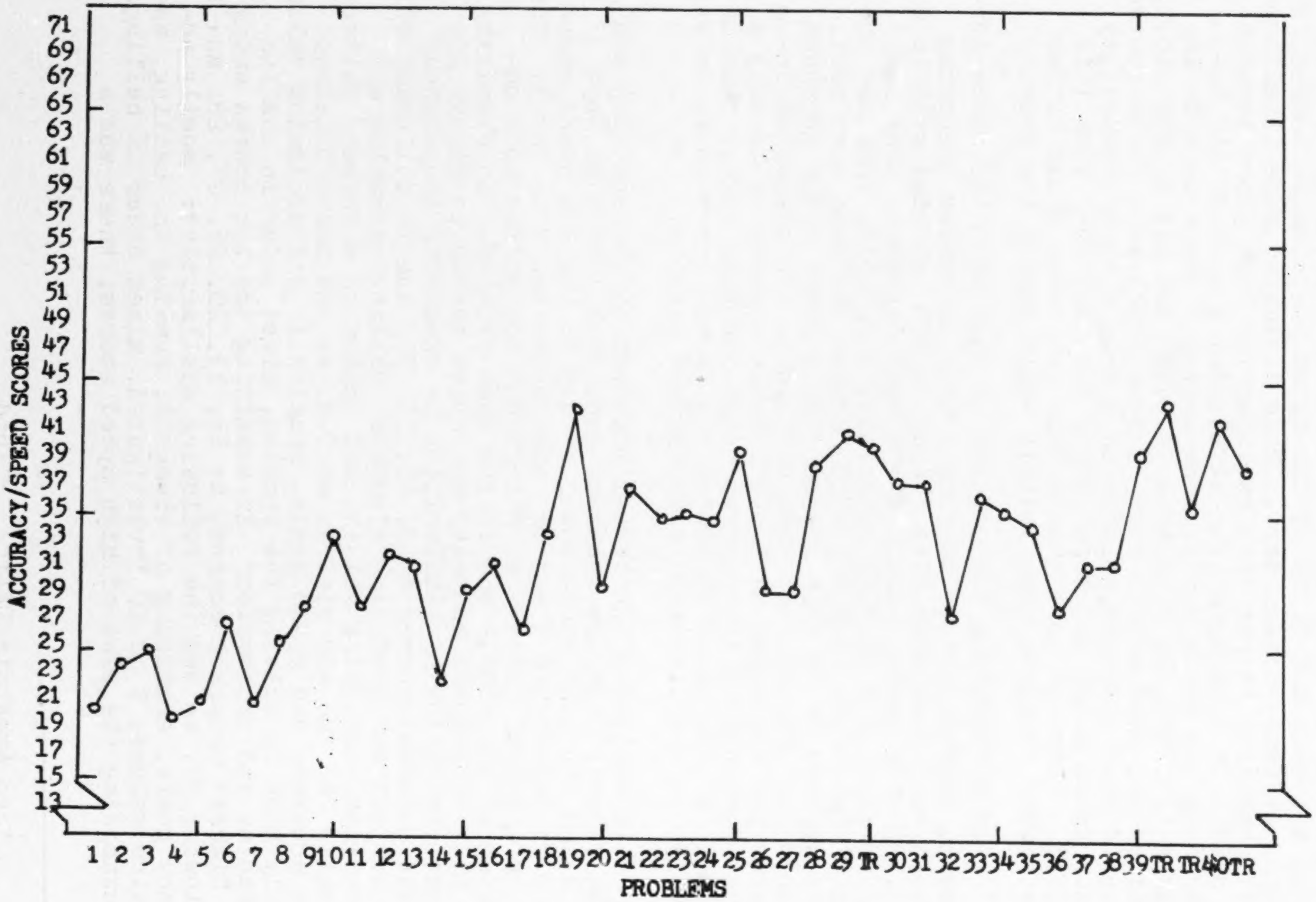

Figure 18.--Subject Five. Plot of mean motor performance scores by problems.

In examining the between-day increases and decreases in motor performance scores,[1] there was a 33.33% increase, 66.66% decrease and 0.00% of the motor performance scores remained the same between days. This indicated more likelihood that forgetting rather than reminiscence took place between the days. In looking at the within-day increases and decreases in the motor performance scores,[2] there were 16 increases (43.24%), 15 decreases (40.54%) and six scores (16.21%) remained the same within days between problems. These scores indicate that there appears to be a very slight probability that a score would increase rather than decrease with this subject. There is more chance that the score would either increase or decrease than that it would remain the same.

In considering the effects of rest upon the motor performance scores,[3] there were many more increases occurring without rest than with rest (14 or 37.83% without rest to 2 or 5.40% with rest). Also 14 (37.83%) decreases occurred without rest to 1 (2.70%) with rest; 5 (13.51%) remained the same without rest, and 1 (2.70%) stayed the same with rest. There appears to be more chance that a score would increase or decrease without rest than with rest. In comparing increases and decreases with rest, there appears to be only a slight possibility that scores would increase rather than decrease. In two cases (5.40% of the cases) rises could be attributed to the dissipation of fatigue factors.

In analyzing the verbal problems by the accuracy and speed scores,[4] the low accuracy mean score was 0 on days 3 and 4 and the high score was 2 on day 3; the low speed score was 0 on days 3 and 4 and the high score was 2 on day 3. This was an atypical pattern with high and low scores both occurring in the middle and in the same problem. In examining the plot of highest accuracy and speed scores in Figure 19, we see the following similarities in examining the highest of the accuracy scores at 3, 23, 33, 38, and TR following 40; the subject was examining elements, calling variables and properties, assigning values, and employing a forward pattern of call. At the one plateau at 4-8, we see the following: both accuracy and speed goals, reading in and assigning values, T only used in solving the problem, mixed order in calling variables and properties. In examining the low scores among the highest accuracy scores, at 18, 19, 20, 26, 27, 28, and TR following 29, we see the following similarities: mostly accuracy goals, examining of elements, reading in, calling, assigning values, T or TC investigated, mixed order in calling. In examining the plot of high speed scores, there was a

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[1] See Appendix LXII. [2] Ibid.

[3] See Appendix LXIII. [4] See Appendix LXIV.

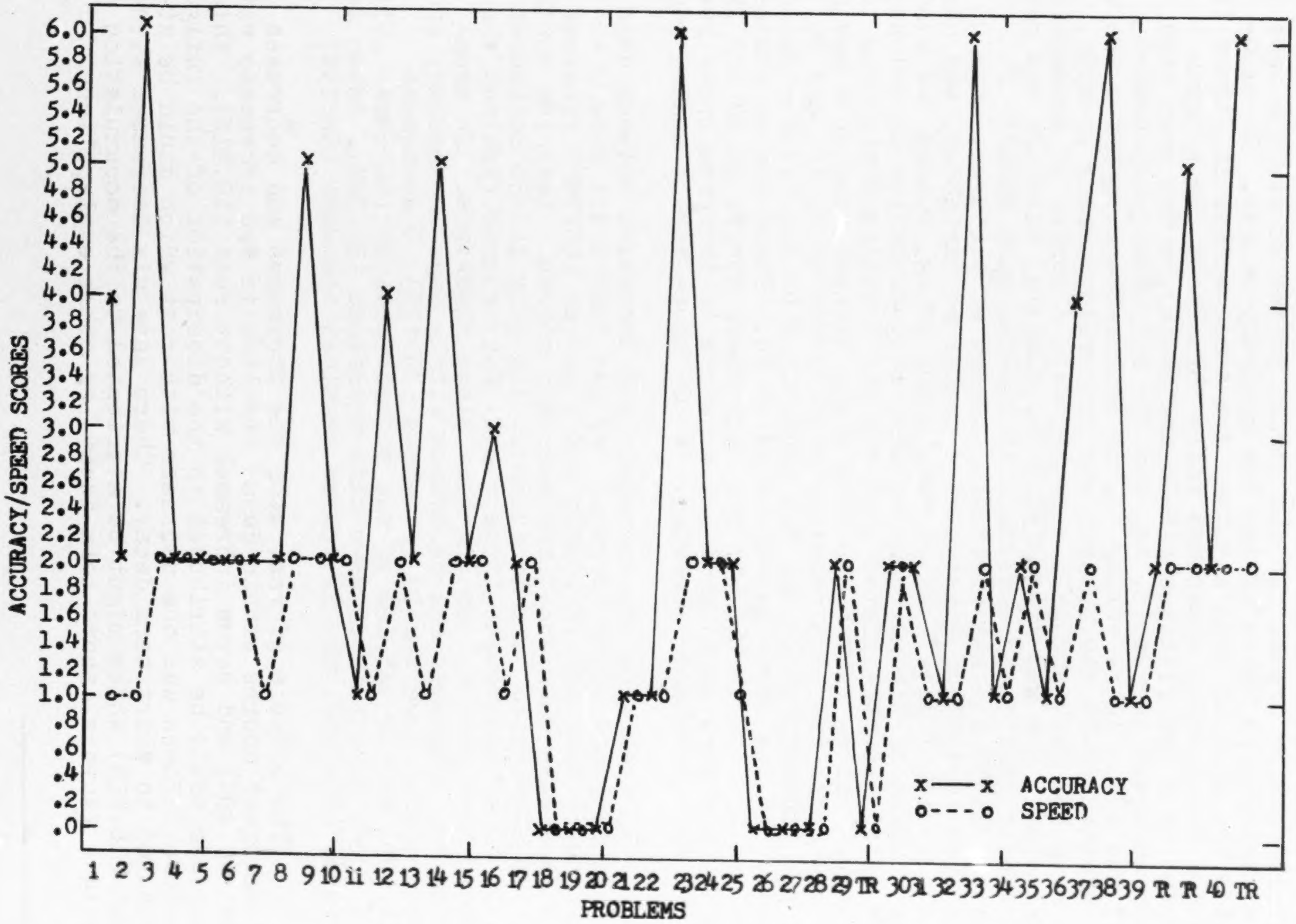

Figure 19.--Subject Five. Plot of high accuracy and speed scores by problems.

plateauing of high scores around 2 as with Subject Four; also, many scores stood at 1. A few scores were 0. For the 1 and 2 scores, one can examine the general pattern of the Verbal-Motor Behavior Graph. At the lowest scores we see the same similarities as those of the low accuracy scores. In examining the plot of mean accuracy and speed scores in Figure 20, we see fluctuating rises and falls throughout the program marked by a few plateaus (18-20 and 24-36), a few very high mean accuracy scores (3, 14, and 25) and mean speed scores (17 and 25). In referring to the Verbal-Motor Behavior Graph, at plateau 18-20 the subject was primarily working on spin, arching her back and grip together with a number of accompanying variables. She was disgusted at episode 19, although she said it "feels good"; and uncertain at 20--"as much spin"? At plateau 24-36 she was uncertain, looked at pictures, came up with new variables, questioned a number of variables, was disgusted, didn't know what she was doing wrong, blamed the wind, was working on timing, came up with many tentative solutions, and ended with the stated goal she was "getting everything together." After that her scores rose, dropped, and rose again. In examining the high accuracy mean scores at 3, 14, and 25, we see accuracy goals and the acceptance of her serve--"feels good"; but the serve was too hard at 14. There was no stated goal at 25. In looking at the high speed scores at 17 and 25, we see a stated speed goal and a desire to increase spin; however, this decreased accuracy. At 25 there was no staged goal.

In examining the increases and decreases between days in accuracy and speed scores,[1] we see that there were 0 increases, 1 decrease (16.66%), and 5 scores (83.33%) remained the same with both speed and accuracy scores. Learning could not be attributed to reminiscence, and only 16.66% decreases could be attributed to forgetting. Most scores remained the same. Most of the learning took place elsewhere. In examining the increases and decreases within days in accuracy and speed scores,[2] we see 13 increases (35.13%), 8 decreases (21.62%) and 16 (43.24% of the scores remained the same. With the speed scores there were nine increases (24.32%), seven decreases (18.91%), and 21 scores remained the same (56.75%).

The effects of rest upon the increases and decreases of accuracy scores within days[3] resulted in two increases with rest (5.40%) and seven increases without rest (18.91%). This increase could be attributed to the dissipation of the fatigue factors. There was one decrease with rest which could be attributed to short term decay. There were six decreases without rest (16.21%) which might be attributed to the accumulation of fatigue factors, short term decay, or other explanations.

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[1] See Appendix LXV for the complete analysis. [2] Ibid.

[3] See Appendix LXVI.

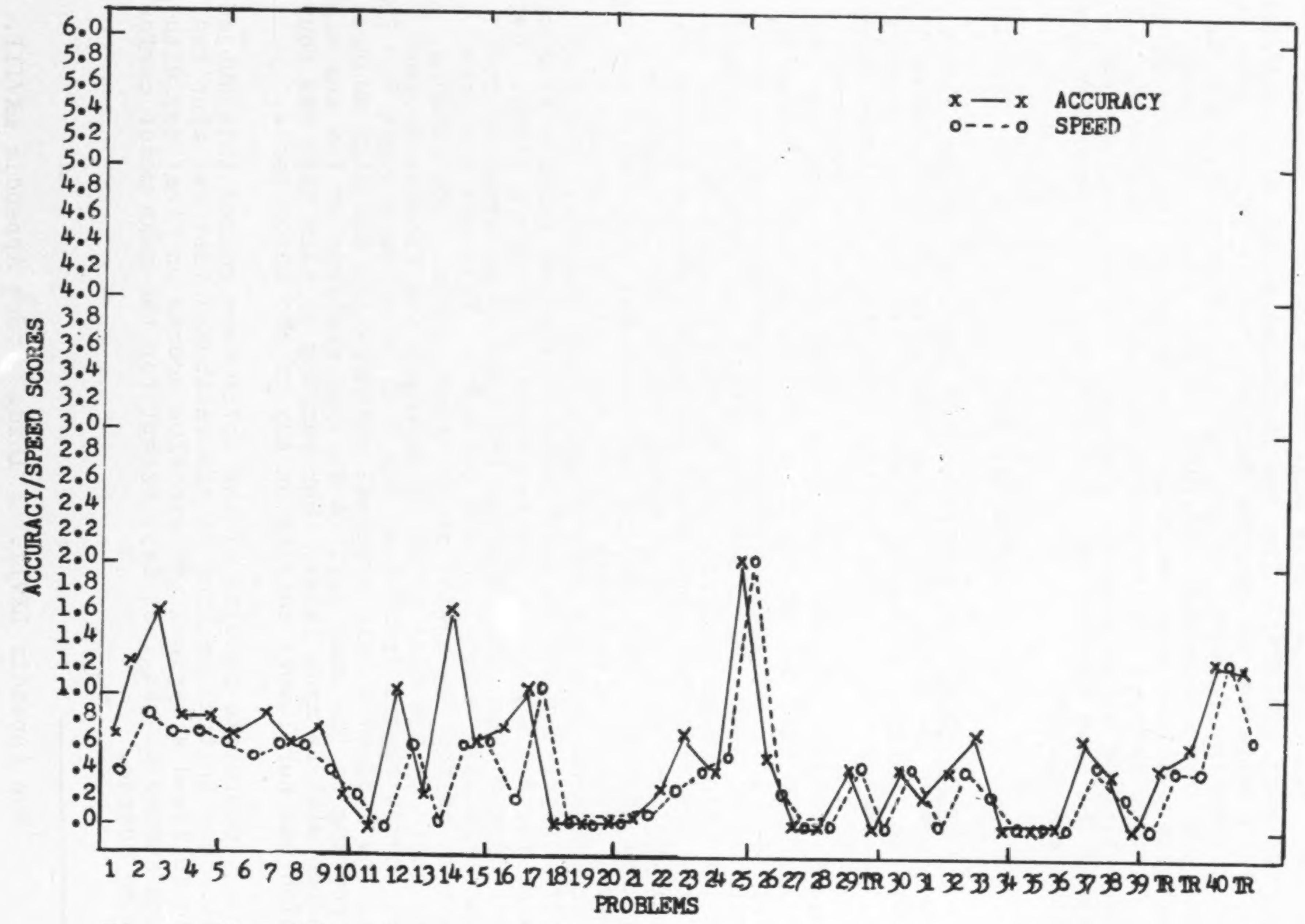

Figure 20.--Subject Five. Plot of mean accuracy and speed scores by problems. (Maximum accuracy = 6. Maximum speed = 4).

One score remained the same with rest (2.70%) and 20 scores stayed the same without rest (54.05%). We see the following effects of rest upon the increases and decreases of the speed scores: two increases with rest (5.40% and 11 increases without rest (29.72%). The two increases could be attributed to the dissipation of fatigue factors, the 11 without rest to other learning factors. There was one decrease (2.70%)with rest and seven decreases (18.91%) without rest. The seven decreases without rest could be attributed to the accumulation of fatigue factors, the decrease with rest to short-term forgetting or other learning factors. Fifteen scores remained the same without rest (40.54%) and one stayed the same with rest (2.70%)

Subject Six

Motor data. On the wallboard test the subject had a raw score of 26 which was in the 59th percentile (T-Score 52) compared to other beginning students. She was about average on this motor skill. Her ranking compared to the other subjects in this experiment was two. On the Hewitt serve accuracy test[1] her scores went from 4 (T-Score 53) on day 1 to 19 (T-Score over 80) on day 5, a typical pattern. On day 6 (her last day) her score dropped very low which may be attributed to wind, short practice period, or watching herself on the television monitor. Her ranking on this test was 1. On the Hewitt serve speed test[2] her scores ranged from 4 (T-Score 53) on day 1 to 12 (T-Score 75) on day 6; again, a typical pattern. Her ranking was two. Her mean daily accuracy scores[3] ranged from .67 on day 1 to 1.02 on day 3. This differed from the Hewitt serve test results. The high score on day 3 might be attributed to weather factors although other factors appear in the Verbal-Motor Behavior Graph. Her ranking was two. The range of her mean daily speed scores[4] went from .43 on day 1 to .90 on day 3. This was the same pattern as for the Hewitt serve speed scores. Her ranking was one. On the mean motor performance performance scores[5] her scores ranged from 25 on day 5 to 58 on days 4 and 5. This was the subject's only atypical pattern--low and high scores appearing on the same day. A further analysis of low and high scores will be made later. Her ranking on this test was four, which was her lowest ranking on any of the motor tests.

Composite results of the motor data ranked this subject two. Her initial ranking on the wallboard test was also two. She followed a typical pattern (low scores on first day with high scores on the last day) except for the mean motor performance scores.

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[1] See Appendix LXVII. [2] Ibid. [3] See Appendix LXVIII.

[4] Ibid. [5] See Appendix LXXII.

Verbal data. The order the subject read in variables, properties and elements[1] was: form--feel, grip (steady), position of racket face (R), wrist (flexion, extension, hyperextension), the ball hit down, vertical position of ball toss (T), accuracy, speed, follow through, contact on center of the racket, foot action, backswing, movement on the court, bend knees, eyes on the ball, balance, horizontal position of the ball toss (C), wrist action (horizontally), reach, forward swing, timing, arch, body positioning, elbow (bent or straight), racket brought up, the ball hit up, step back, slice, wind, forearm (shorter or longer), contact on top of the ball, left leg stationary, lean to the left, and the racket follows the ball in the air. The subject read in 31 variables on the first two days, more than the number of variables read in on the last four days combined! She read in only one variable on the fourth day, none on the fifth. She read in the main goals of accuracy and speed, the subgoal of form, and the CRT variables early. Most of the elements were read in from the middle of the program to near the end.

In analyzing the Verbal Motor Behavior Graph[2] as to agreements and disagreements with the GSPS model, the CRT variables were considered first. She read in these variables in the following order: RTC. The most prevalent pattern was TRC. The portion RT predominated early; C was picked up in problem 7. The reverse calling pattern predominated in negative and positive solutions; the mixed pattern followed by negative pattern predominated in the tentative or questionable solutions. Negative solutions were more common than positive or tentatively accepted solutions. The subject showed disgust, tiredness, and soreness toward the end of the learning sessions. Negative solutions predominated near the beginning and end of the sessions, positive solutions in the middle. After observing herself on the television monitor, she reacted with negative solutions and feelings of disgust. The order of reading in the C variable was: C_4, C_3, C_5, C_1; the order for the T variable was: T_3, T_2, T_1; the order for R was: R_3, R_2, R_1, and R_{left} (subject's individual value).

Combined verbal/motor analysis. In analyzing the verbal problems by the motor performance scores[3], the range of scores went from 25 on day 5 to 58 on days 4 and 5. In examining the highest motor scores only[1] there were 36 within-problem increases and only one between-problem increase among these scores. All of the rises, including the one between problem rise, took place without the possibility of reminiscence occurring. These highest scores per problem are plotted in Figure 21. In analyzing these highest motor score episodes using the Verbal Motor Behavior Graph, we see the following pattern: assigned values, tested variables, combined variables, combined variables and properties, assigned equivalences, combined properties into elements, tested properties, recycled through the above processes, narrowed down properties and elements, and assigned new equivalences. During the earliest scores she was assigning values, testing one variable, and combining variables. In the middle of the program she combined variables and properties, assigned values, combined variables and properties into elements, tested and enlarged the number of properties. Late in the learning situation the subject narrowed down the number of properties into larger elements which were easier to call, tested, investigated single variables, and assigned equivalences. At the highest score (12) the subject was increasing accuracy and decreasing speed, working on form, calling five properties, did not read in any new variables or properties, assigned or called four values, used RC to solve the problem, and used the reverse pattern in calling the variables. At the lowest of the highest scores (33) she was working on accuracy and form. She read in one variable, called two properties, assigned one value, did not use either C, R, or T, employed a reverse pattern in calling variables, and was tired and disgusted. There were three short plateaus: 5-7, 9-11, and 15-17. In looking at the Verbal Motor Behavior Graph at these plateaus, we see at 5-7 the subject was working on increasing accuracy, debating between various heights of ball toss, reading in six new variables, attacking the element of balance, assigning equivalences (R = hit square and aim), calling six properties, calling or reading in nine values; calling TRC to solve the problem, and using reverse and forward patterns in calling the variables; the solutions are either positive or negative and she has a positive attitude toward the serves. At 9-11 (all positive solutions) her main goal was accuracy, she called the elements balance and feeling, read in one variable, was working on various heights of ball toss, called seven variables, read in or called eight values, used TCR to solve the problem, and used forward or reverse patterns in calling. At 15-17 the main goals were to increase accuracy and speed; she attacked the elements of timing and form, assigned equivalances (B = RCH), added variables (T + B; RCH + T + B + T_3); she did not read in any new properties,

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[1] See Appendix LXIX.

[2] See Appendix LXX for the complete Verbal Motor Behavior Graph and Appendix LXXI for a synopsis of the graph.

[3] See Appendix LXXII for the complete analysis.

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[1] See Appendix LXXIII.

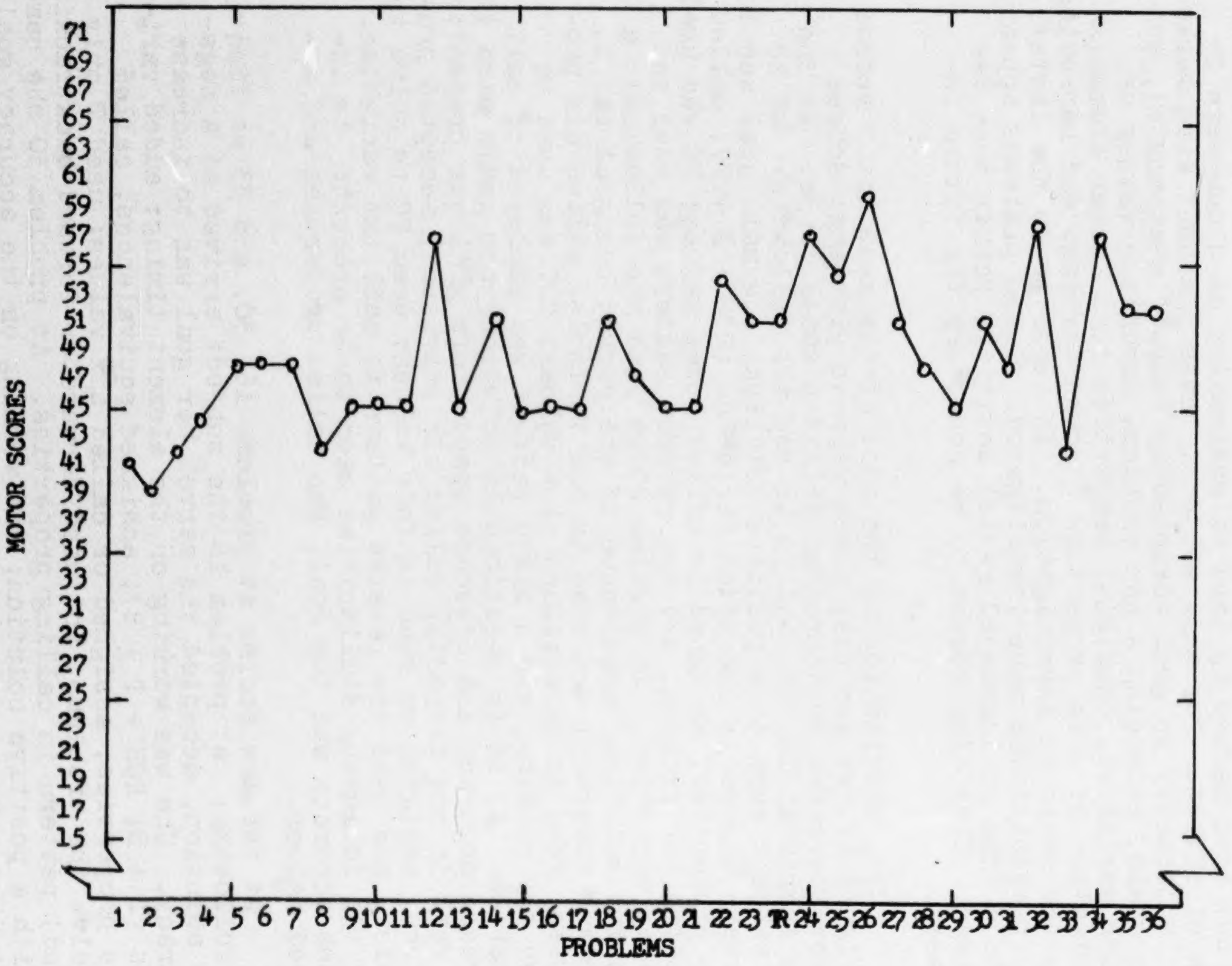

Figure 21.--Subject Six. Plot of high motor performance scores by problems.

called three properties only (was testing these three), called or read in seven values, used TRC to solve the problem, used reverse or forward-backtracking (mixed) patterns in calling the variables; solutions were positive, rejected the solutions, accepted or tentatively accepted the serves. Plateaus did not seem marked by lack of motivation or a decrease in lack of effort. For this subject, these plateaus were marked by: insecurity in goal (denoted by "maybe" statements), too many goals, attending a new problem, assigning values or adding variables, combining properties into larger elements, elimination of some properties through testing, and narrowing down the scope of investigation. In order to do the latter, many possibilities were investigated. These plateaus appear to be a time of increased mental activity, rather than decreased. They also appear to be necessary for future increases.

Upon examination of the plot of the mean motor scores in Figure 22, we see that there were no plateaus; scores either increased or decreased within a small range. At the high scores at 18, 24, and 36 we see the following: at 18 the subject came to a positive solution, the main goal was to increase accuracy; she added variables (RCH + B + T), called five properties, assigned or called three values; TC was used to solve the problem, and the reverse pattern was used in calling variables. At problem 24 we find the following: a negative solution, acceptance of the serve; her goal was to increase accuracy; she read in one variable, called six properties, read in or assigned nine values; CRT was used to solve the problem, and a mixed pattern was employed to call variables. At 26 (a questionable solution) her goals were to increase accuracy and decrease speed; form goal was present; she read in one property, called six previously accepted properties, assigned or read in four values; used TC to solve the problem, and used the reverse pattern to call the variables. Only the following similarities seem to be present: to increase accuracy was the goal; she called properties and assigned values.

At the low scores at problems 16, 30, and 33 we find the following: at problem 16 the subject arrived at a negative solution, accepted the serve, her goal was to increase accuracy. She was working on the element timing; added variables (T + B; RCH + T + B), assigned equivalences, called three properties, assigned or called six values; used T only to solve the problems, and used forward or forward-backtracking (mixed) pattern in calling properties. At problem 30 she came up with a positive solution; was working on the accuracy goal--right hand corner; was working on the elements timing, form, and balance; read in two properties; called 10 properties; assigned or read in 12 values; used RTC to solve the problem and employed forward backtracking (mixed) patterns to call the variables. At problem 33 we find a tentative solution: her goal was to increase accuracy, she was working on the

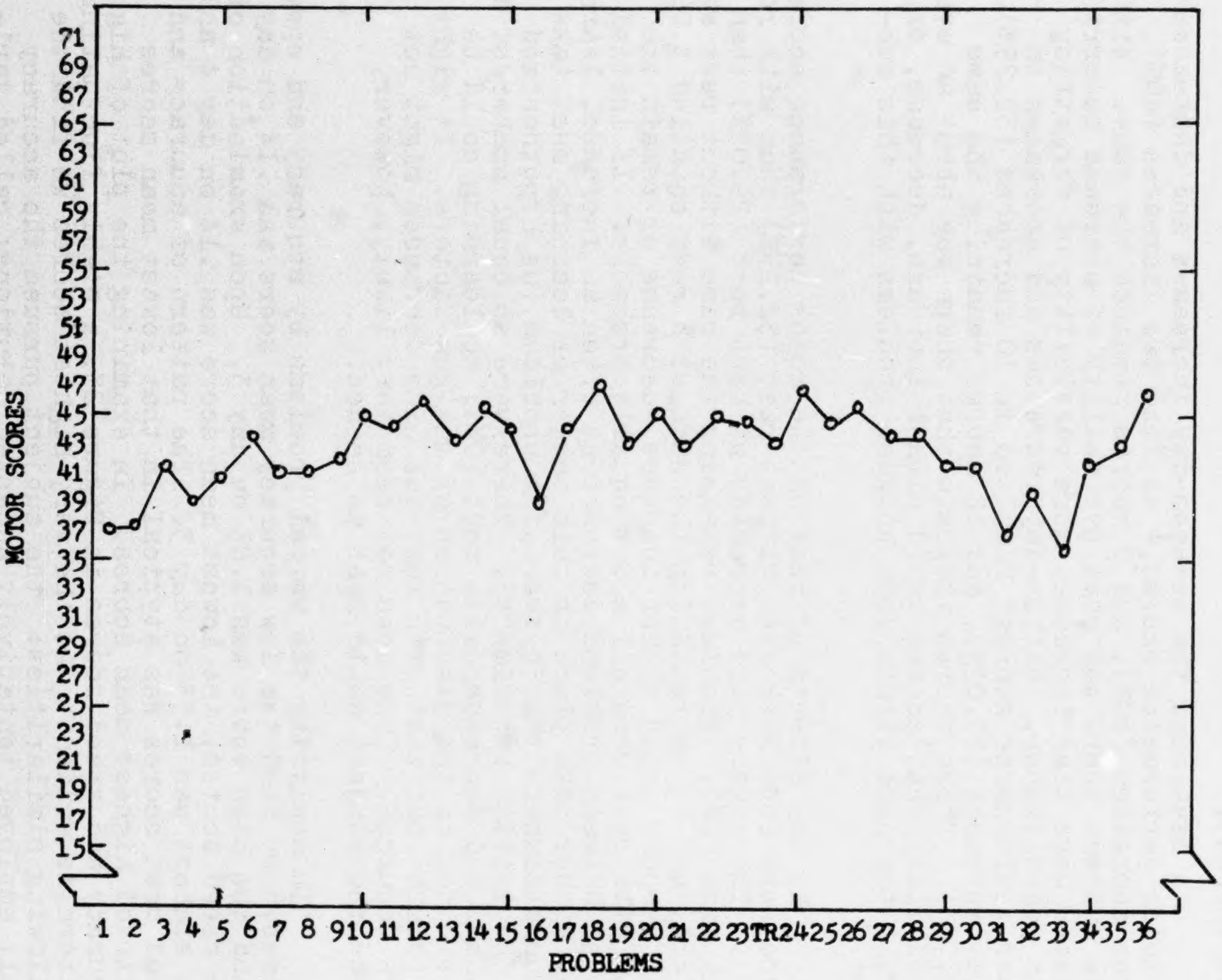

Figure 22.--Subject Six. Plot of mean motor performance scores by problems.

element balance, called four properties, assigned or read in three values, used CR to solve the problem, and employed a reverse pattern in calling the variables. Common operations occurring at these low mean scores were: accuracy goal, called properties, read and called values (same as the highest mean scores).

In examining the between-day increases and decreases in motor performance scores,[1] we find two increases (40%), three decreases (60%), and 0 scores remained the same. With this subject there was more probability of decrease occurring between days than increase, more possibility of forgetting than reminiscence. Within-day increases and decreases in motor performance scores[2] resulted in 10 increases (32.25%), nine decreases (29.03%), and 12 scores remaining the same (38.70%). These scores indicate that there was about an even possibility that scores would either increase, decrease, or remain the same within days between problems with this subject.

In the effects of rest on the motor performance scores,[3] there were more increases without rest (32.25%) than with rest (0%). There were more decreases without rest (29.03%) than with rest (0%). Problems remaining the same without rest were 35.48%, and those remaining the same with rest equalled 3.22%. That a score would either increase, decrease or remain the same with rest were all about equally probable. If initial scores between problems decrease as often as increase, learning must either take place in this manner or learning must take place elsewhere than between the problems (as hypothesized in the initial experiment). There were an equal number of increases and decreases with rest (0%); no learning could be attributed to the dissipation of fatigue factors. It might be pointed out that with rest the nine decreases might not have occurred. This does not seem very likely, however, since the subject could rest as needed.

In analyzing the verbal problems by accuracy and speed scores,[4] we find the low accuracy mean score was .14 on day 4 and the high score was 1.83 on day 3. Upon examination of the speed scores, the lowest mean score was .14 on day 4 and the highest was 1.33 on day 3. The pattern of accuracy and speed mean scores was atypical in that lowest mean scores followed highest mean scores. In examining the plot of high accuracy and speed scores in Figure 23, a highly fluctuating pattern is evident. At the very highest scores we find the following similarities: the subject pursued the accuracy goal; employed tentatively accepted solutions; called vari-

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[1] See Appendix LXXIV. [2] Ibid.

[3] See Appendix LXXV. [4] See Appendix LXXVI.

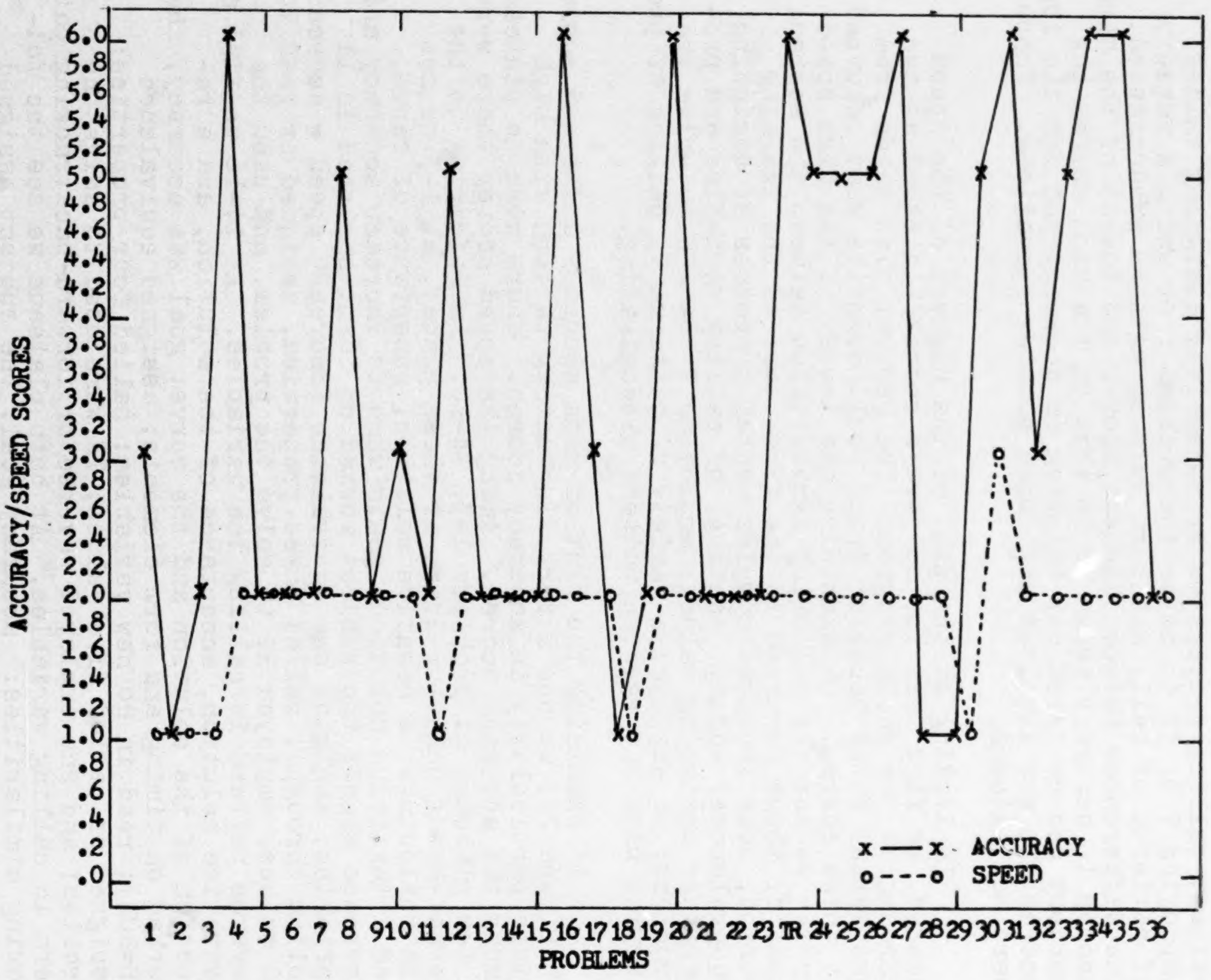

Figure 23.--Subject Six. Plot of high accuracy and speed scores by problems. (Maximum accuracy = 6. Maximum speed = 4).

ables; assigned values; T, TR, or TC predominated in solving the problems; a variety of pattern was used; reverse pattern of calling was most predominant. In examining the lowest of the high accuracy scores we see the following similarities: the subject was working on a more complex mental task such as assigning equivalence; adding variables; testing two values; calling properties or variables; assigning values; employing T or TC to solve the problem ; or using a variety of patterns of call, although reverse pattern predominated. The differences between highest scores and lowest of the high scores in accuracy seems to be that on the high scores the subject had centered her thinking on accuracy and for the low scores she was involved with more complex operations. There were no plateaus.

In looking at the plot of the highest of the speed scores, we find that the subject's scores plateaued at two throughout the whole program. The general plan taken from the Verbal Motor Behavior Graph would describe what occurred at these scores. On examining the lowest of the high speed scores we see the following similarities between the scores: most of these occurred in the first part of the learning period, most involved complex mental processes of assigning equivalences, adding, testing, or calling variables and properties; assigning values; employing T or TRC to solve the problems; or employed a variety of patterns in calling of properties with the reverse pattern predominating.

In examining the plot of mean accuracy and speed scores in Figure 24, we see a very fluctuating pattern with high rises particularly in accuracy scores. There were no plateaus among the accuracy scores. Among the speed scores there were a few plateaus at problems 1-3, 14-16. In referring to the Verbal-Motor Behavior Graph at these places, at 1-3 we see the following: a negative solution, acceptance of serve, and a tentative solution; goals were to increase accuracy and decrease speed; the subject worked on form; she read in 11 variables, assigned one equivalence (decrease speed = decrease follow through), called three properties, assigned or read in 10 values, employed RT to solve the problem, and used the reverse pattern in calling the variables. At 14-16 we find a tentative solution, acceptance of the solution, and a rejection of the solution and the serve; goal was accuracy, she worked on timing and form elements; assigned equivalence (B=RCH); read in no new variables, called four properties; assigned or called five values; TR were used to solve the problem; and she employed reverse or forward-backtracking pattern in calling variables. At both plateaus we see the following similarities: accuracy goal; the subject assigned equivalence, worked on the element of form, called and assigned values, and used the reverse pattern in calling variables.

In examining the highest mean accuracy scores at 4,

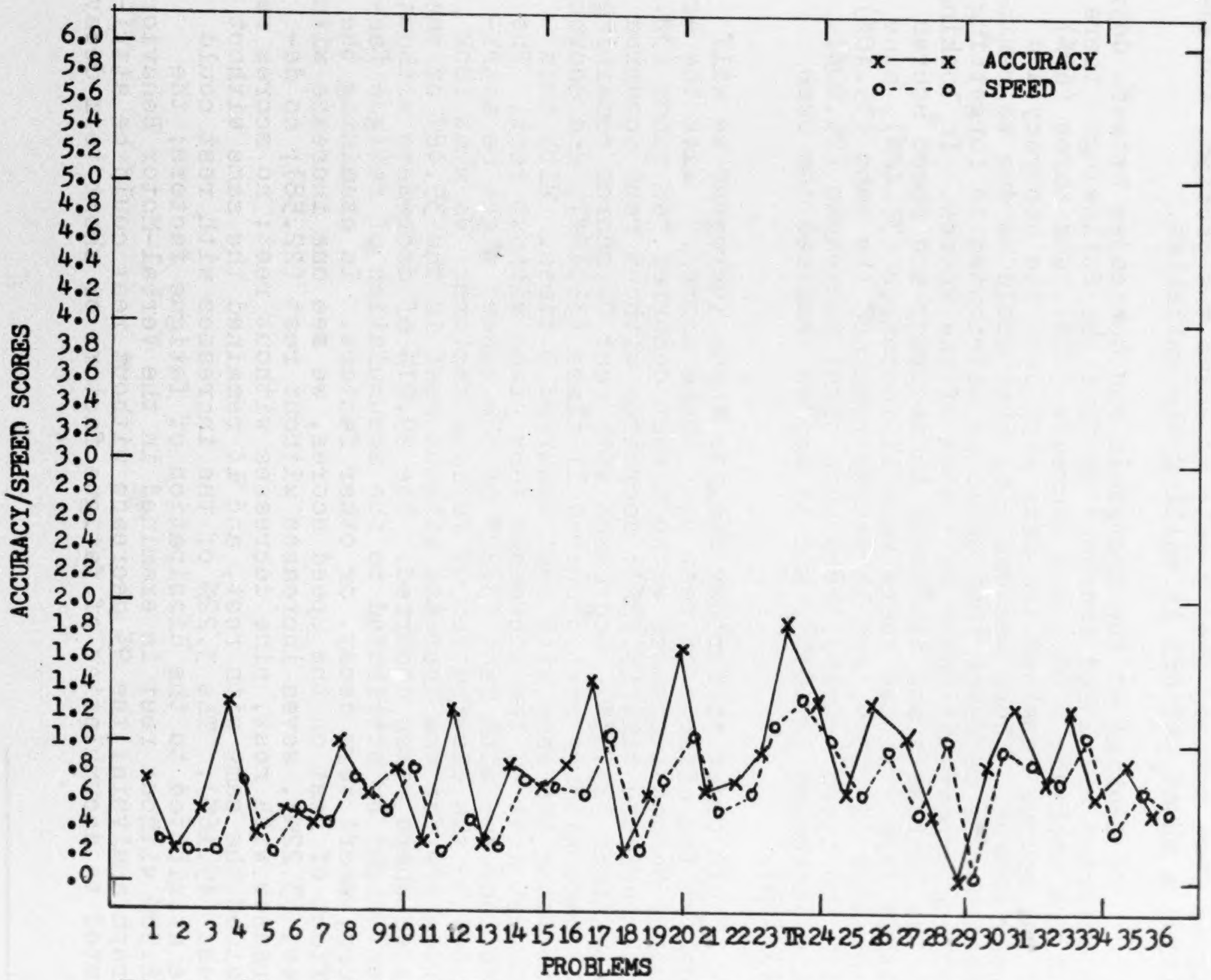

Figure 24.--Subject Six. Plot of mean accuracy and speed scores by problems. (Maximum accuracy = 6. Maximum speed = 4).

12, 17, 20, and 23 the following similarities can be seen: the subject employed both accuracy and speed goals; called properties, called a large number of values, and employed a reverse pattern in calling variables for all but one problem. Upon examining the lowest scores in both accuracy and speed scores at problem 29 we see: a tentative solution, a testing period, subject read in one property, tested values of this property, called six formerly used properties, called or assigned five values, used T only to solve the problem, and employed a mixed pattern in calling the variables.

In looking at the increases and decreases between days in accuracy and speed scores,[1] we find the following: there was one increase (20%), one decrease (20%), and three (60%) of the scores remained the same with both the accuracy and speed scores. There was one rise that could be due to reminiscence, one decrease that could be attributed to forgetting; nothing appears to occur with most of the scores. In looking at the increases and decreases in accuracy and speed scores within days,[3] we see there were 11 increases (35.48%), nine decreases (29.03%), and 11 scores remained the same (35.48%). With the speed scores, there were eight increases (25.80%), nine decreases (29.03%), and 14 scores remained the same (45.16%).

In order to further analyze these increases we will look at the effects of rest upon these scores.[3] With the accuracy scores increases without rest occurred ten times (32.25%), with rest one time (3.22%); decreases without rest occurred nine times (29.03%), decreases with rest 0, scores remaining the same without rest occurred 11 times (35.48%), and scores remaining the same with rest occurred 0 times. With this subject most of the increases took place without rest. The one increase with rest (3.22% of the cases) might be attributed to the dissipation of fatigue factors. We must look elsewhere for the increase without rest in the 35.48% of the cases where rises occurred. The 29.07% of decreases without rest might be attributed to the accumulation of fatigue factors, short term decay, or other factors. In examining the effect of rest on the speed scores, we see one increase with rest (3.22%), seven increases without rest (22.58); no decreases with rest, nine decreases without rest; no scores remained the same with rest, and 14 remained the same without rest (45.16%). The 3.22% of the increases with rest could be attributed to the dissipation of fatigue factors; the 22.58% without rest is examined in the Verbal-Motor Behavior Graph analysis; the 9% decrease without rest could be attributed to accumulation of fatigue factors or short term decay.

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[1] See Appendix LXXVII. [2] Ibid. [3] See Appendix LXXVIII.

More scores remained the same than either increased or decreased indicating that most of the learning must take place within the problems rather than between them. The zero decrease with rest indicates rest contributes to neither forgetting nor learning, but to remembering with this subject.

CHAPTER V

RESULTS AND DISCUSSION

Comparison of Subjects

Motor data. The subjects were ranked in the following order on the wallboard test:[1] 4, 5, 3, 1, 6, and 2. It is interesting to note that of the six subjects who considered themselves better than average in general motor ability, three scored below average (two way below average), two scored average, and only one scored well above average. On the Hewitt serve accuracy tests[2] the high scores occurred on days 3-7 and they centered around days 3 and 5. There were no particularly high scoring days. On the Hewitt serve speed tests,[3] high scores appeared on days 3-7, centering around days 3 and 5. The high scores on the mean daily accuracy scores[4] appeared on days 1, 3, and 7; most centered around days 3 and 7. The mean daily speed high scores[5] appeared on days 1, 3, 4, and 7; but they centered around days 3 and 7. In examining the range of motor scores,[6] low scores by most subjects took place on days 1 and 2, although two subjects had low scores on day 5. High scores were most frequent on day 4, but high scores occurred on all days but the first. From these scores we see that, although some high scores occurred before day 4, the majority appeared day 4 and thereafter. With the previous study it was found that the first signs of boredom appeared on day 4. What occurred with that subject and is occurring with these six subjects is that by day 4 most of the variables have been read in and explored to some degree. Thereafter, most of the time is spent testing old variables, making new combinations of these variables and properties, assigning equivalences, and other operations. Rather than exploring new variables and properties, they are now spending their time applying operations within their framework of properties, which might not be as adventuresome a learning experience. However, due to the experimental situation, these six subjects did not show signs of boredom or lack of motivation as learners might do without the motivation of a television camera.

It can be noted that learning cannot be entirely measured by motor performance scores at a particular time and place, for in the learning situation the score is dependent upon the operations the subject is utilizing. In order to eliminate undesirable values and variables, combine variables and assign values and equivalences, the subject must test these values and operations. These tests result in low scores, high scores, and plateaus depending upon the goodness of the property applied and how the property fits into the total framework being developed by the subject. These scores are all parts of the total learning situation. The struggle to learn is marked by a slowly rising mean score with many fluctuations as can be seen by most of the motor score plots of most of the subjects.

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[1] See Appendix LXXIX. [2] See Appendix LXXX.

[3] See Appendix LXXXI. [4] See Appendix LXXXII.

[5] See Appendix LXXXIII. [6] See Appendix LXXXIV.

In comparing the performance scores of all the subjects,[1] it can be seen that the initial wallboard test was a good predictor of the final outcomes of the serve motor tests. Only one subject was out of order.

Verbal data. In considering the number of properties[2] read in by these subjects, the vast majority of variables were read in during days 1 and 2. By day 4 (except for Subject Four) most of the variables were read in. Subject Four, who read in 10 variables on day 5, was the highest scoring subject on the motor tests. Subjects Five and Six experienced soreness, tiredness or nervousness on day 5 which might be one reason for the drop in the reading in of variables, although the scores for Subjects One, Two, and Three dropped off sharply after day 4 also.

In examining the between-day increases and decreases in motor performance scores of all the subjects,[3] there were 12 increases (34.25%), 21 decreases (60.00%), and two (5.71%) scores remaining the same between days. This indicates that 34.28% of the scores could be attributed to reminiscence, 60% could be attributed to forgetting, and 5.71% could be attributed to remembering. The GSPS model must therefore take into consideration the large forgetting which occurred between days and recognize that there was less possibility that reminiscence would occur or that the serve would be remembered as it was at the end of the previous day.

In examining the within-day increases and decreases in motor performance scores of all subjects,[4] there were 81 increases (42.63%), 71 decreases (37.36%), and 38 (20.00%) of the scores remained the same. This indicates that within-day increases should receive first priority, decreases second, and scores remaining the same a small priority in the model.

In examining the effects of rest upon these scores,[5] we see that 13 (6.84%) increases occurred with rest, 66 (34.73%) increases occurred without rest; 13 (6.84%) decreases occurred with rest, 60 (31.57%) occurred without rest; 5 (2.63%) remained the same with rest, and 33 (17.36% remained the same without rest. This indicates that 6.84% of the increases within days could be attributed to the dissipation of fatigue factors (although this does not rule out other reasons for the increases). Reasons for the 34.73% increases which occurred without rest will be sought within the verbal-motor data later. It is possible that 6.84% decreases could be attributed to short term decay, but the large percentage of decreases without rest must either be attributed to the accumulation of fatigue factors or other learning factors found in the verbal-motor data. The very low percentage of scores that remained the same within days following a short rest seems to indicate that nothing in particular occurred between these problems to influence these scores. The 17.36% of scores that remained the same without rest appear to be necessary to the learning situation. Within-day increases without rest were 80% greater than those with rest, showing that reminiscence or rest played a minor part in the total learning picture of these subjects.

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[1] See Appendices LXXXV, LXXXVI, and LXXXVII.

[2] See Appendix LXXXVIII. [3] See Appendix LXXXIX.

[4] See Appendix XC. [5] See Appendix XCI.

In examining the between-day increases and decreases in accuracy and speed scores[1] of all the subjects, we find the following taking place with the accuracy scores: there were four (11.42%) increases, 10 (28.57%) decreases, 21 (60.00%) remained the same. The small percentage of increases in accuracy scores could be attributed to reminiscence, the 28.57% decrease to forgetting, and the fact that 60% remained the same between days seems to be due to remembering. With the speed scores we see there were five (14.28%) increases, eight (22.85%) decreases, and 22 (62.85%) remained the same. The same explanations as under accuracy (above) could be given here also.

In looking at the within-day increases and decreases in the accuracy and speed scores of all subjects,[2] it can be seen that with the accuracy scores there were 61 (31.77%) increases, 36 (18.75%) decreases, and 95 (49.47%) remained the same. With the speed scores there were 50 (26.04%) increases, 36 (18.75%) decreases, and 106 (55.20%) remained the same. It is interesting to note that in spite of the large number of initial scores that remained the same, learning took place. Two explanations are given for this: (1) the large number of scores remaining the same were indicative of testing periods and necessary to the learning process and (2) significantly more learning took place within problems rather than between.

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[1] See Appendix XCII. [2] See Appencix XCIII.

In examining the effects of rest upon the accuracy and speed scores,[1] we see the following: with the accuracy scores there were 11 (5.72%) increases in scores with rest, 44 (22.91%) increases without rest; six (3.12%) decreases with rest, 31 (16.14%) decreases without rest; 21 (10.93%) scores remaining the same with rest, and 79 (41.14%) remaining the same without rest. There was much more probability that increases would occur without rest than with rest. Decreases without rest also exceeded those with rest. Scores remaining the same without rest exceeded both increases and decreases.

Only a very small percent of the scores (5.72%) could possibly be attributed to dissipation of fatigue factors; the increase without rest (22.11%) must be attributed to other factors. Decreases with rest could be attributed to short term decay. In light of the fact that there was a steadily rising but largely fluctuating mean score increase, and in light of the fact that so many initial scores remained the same, learning must have taken place within the problems rather than between. Factors of reminiscence, dissipation of fatigue factors, forgetting, and short term decay played a very small part in the programs of these subjects in the total learning picture. In looking at the speed scores, there were seven increases with rest (3.64%), 46 (23.95%) increases without rest, six (3.23%) decreases with rest, 32 (16.66%) decreases without rest, 18 (9.37%) stayed the same with rest, 83 (43.22%) stayed the same without rest. As with the accuracy scores only a small percentage of the increase in scores could be attributed to the dissipation of fatigue factors. Decreases with rest could be attributed to a short decay period. The reason for the large number of decreases without rest were sought in the verbal data and appear later. There was a 26% probability that an initial motor score would result in an increased score. This seems to indicate that most of the learning took place within the problems rather than between them.

In analyzing the highest motor performance scores in each problem,[2] we see the following general pattern for all the subjects: they were investigating single variables, assigning values to variables, testing values, combining values and variables, testing, combining into a larger number of variables and properties, assigning equivalences, narrowing down values, variables and properties by eliminating those which were unsuccessful, combining others into larger subgoals or elements, testing remaining variables individually, assigning values, testing, reassigning equivalences, continuing to narrow down by combining into elements, and continuing with this pattern to the end.

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[1] See Appendix XCIV. [2] See Appendix XCV.

In analyzing the highest accuracy and speed scores in each problem we see the following similarities in goals and operations used to accomplish the task of learning to serve: the subjects were working on the accuracy goal, calling and assigning values, using T, TC, CRT, TCR, or RCT to solve the problem, were employing the reverse calling of variables and properties predominantly, followed by the mixed pattern.

In comparing the lowest scores of each subject we see the following similarities between subjects: they were working on both accuracy and speed goals, dealing with complex elements, assigning equivalences, adding properties, testing two or more variables, calling and assigning values, using T, TR, CT, TC (never more than two of the three main properties) to solve the problem, and using the mixed pattern to call the variables, although forward and reverse patterns were also present.

In comparing the plateaus between the subjects, we see the following similarities: accuracy goals predominated, complex elements were involved, the subjects were testing, assigning equivalences, assigning values, adding variables, reading and calling properties using R, RC, T (usually only one or two of the main properties) to solve the problem, and using the mixed pattern in calling the variables.

In examining all of these similarities, we see that during the plateaus and lowest scoring periods the subjects dealt with more complex processes than during the highest scoring periods. These lowest scoring periods and plateaus appeared to be necessary for obtaining the highest scoring periods. Some of the highest scoring periods occurred during transition periods, indicating that a synthesis of information might take place during some transition periods. The subjects made more frequent use of the main properties CRT during the highest scoring periods. During the lowest scoring periods and plateaus, only one or two of these were used. The reverse pattern predominated during highest scoring periods, mixed order prevailed during both lowest scoring and transition periods. This indicates that when the subjects dealt with more complex materials they jumped among accepted properties to get the ones desired; during highest scoring episodes, when the subjects were not involved in so many operations, they were apt to call properties in a reverse order. There was no pattern of acceptable, rejected or tentatively accepted solutions to problems during either highest scoring, lowest scoring, or plateau periods when looking at only the highest scores for each problem.

In examining the three plots of the raw scores of motor form performance, accuracy, and speed scores we see that high motor performance scores did not accompany high accuracy and speed scores. By sight inspection one would not predict much correlation between the two. Since speed was dependent upon accuracy, high correlation would be expected between these two.

Model changes.[1] The following changes were based on the results of all six subjects. For the suggested order of the CRT variables a better order of reading in these variables would be TRC followed by TCR. Order of T would be: 2, 3, 1; R: 3, 2, 1; and C: 2, 4, 3, 5, 1. Removing R from a prime position to a position equal with the other properties and leaving C and T as the main properties was also considered in light of the results of this experiment. However since only two subjects did not place R in a prime position, it was left there.

The most prevalent pattern in all types of solutions was the reverse (67), followed by mixed (61), and forward (52). For the negative solutions, there were equal numbers of forward, reverse and mixed patterns. For the tentatively accepted solutions, the mixed pattern predominated (16), followed by the reverse pattern (12), and forward pattern (9). For the positive solutions the reverse pattern predominated (30), followed by the mixed pattern (20), and forward pattern (18). Since the positive solutions were the most prominent, the reverse pattern will remain in the model in the position of priority, followed by the mixed, and forward.

Lastly, the order of priority for all the properties and elements except TRC were considered. Accuracy and speed were the main goals read in in positions two and three. The other elements and properties read in by at least three of the six subjects in the order of priority were: timing, contact on center of the racket, follow through, wind, grip (position of), reach, backswing, elbow position, arch, lean, hit--coming over the top of the ball, wrist (horizontal, vertical positions), hit down, step, foot fault, starting position of the body, wrist (hyperextended, extended), whole body, hit--bringing the racket up, contact, movement on the court, bent knees, form--feeling, thinking. There were 36 other elements and properties besides these 28, which could be considered individual properties rather than group.

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[1] See Appendix XCVI.

CHAPTER VI

REVISED GSPS MODEL[1]

1. READ IN Accuracy, Speed: MAIN GOAL.
2. READ IN Desired Serve (A).
3. READ IN Present Serve (B).
4. COMPARE (A) to (B). Does A = B? Yes. GO TO 13 below. If there are differences that can be reduced, GO TO the last step before branching here and advance 1 step. If this is the first time at this stop and No, CONTINUE.
5. CALL SUBGOAL T[a]. (17) to reduce differences. SELECT next value. CALL SUBGOAL 16 TEST VALUE. If value is rejected, SELECT next value. If values are exhausted, GO TO 4. If value is accepted or tentatively accepted but differences still exist, CONTINUE.
6. CALL SUBGOAL R[b] (18) to reduce differences. SELECT next value. Call SUBGOAL 16: TEST value. If value is rejected, SELECT next value. CALL subgoal 16. If values are exhausted and serve is rejected, GO TO 5. If value is accepted, CONTINUE.
7. APPLY R to T. If uncertain, RETEST. If no improvement or negative results, GO TO 6. If improvement, CONTINUE.
8. CALL SUBGOAL C[c] (19) to reduce differences. SELECT value. CALL SUBGOAL 16. If values are exhausted and all values are rejected, GO TO 6. If value is accepted but differences still exist, CONTINUE.
9. APPLY C to R. If uncertain, RETEST; if no improvement or negative results, GO TO 8. If accepted or tentatively accepted but differences still exist, CONTINUE.

10. READ IN NEW PROPERTIES AND ELEMENTS.
11. GO TO SUBGOAL 20. CALL accepted properties and elements as needed to TEST new property or element. If acceptable, STORE new property or element in ACCEPTED PROPERTY AND ELEMENT AREA, and CONTINUE. If not, GO TO 8.
12. APPLY property to C. If uncertain, RETEST. GO TO 11, CALL SUBGOAL 20. If negative results or no improvement, GO TO 8. If Yes, GO TO 4.
13. WRITE: NEW SERVE ACCEPTED and EXIT.
14. PLACE: New Serve Description in Present Serve (A). GO TO 4.

STOP

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16. Subgoal TEST VALUE. MATCH present value to past value. If present value is greater than or equal to past value

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[1] See Appendix XCVIV for the diagrammed model.

RETURN to main program and CONTINUE. If less, REJECT Value and CALL next value that is higher. If none exist, RETURN this information to the main routine.

17. Subgoal T.[a] Order of Call: T_2, T_3, T_1.
18. Subgoal R.[b] Order of Call: R_3, R_2, R_1.
19. Subgoal C.[c] Order of Call: C_2, C_4, C_3, G_5, C_1.
20. Subgoal 20. READ IN NEW PROPERTY. CALL OLD PROPERTIES. Order of Call: Reverse, Mixed, Forward. Order of priority for group properties and elements: TIM, OC, F, E, RC, G, W, B, ARCH, LEAN, TOP, W_{hor}, FEELS, HD, W, TK, WB, BNG UP, CON, MOC, S_{14}, H, P, S_{13}. Individual properties: unique to each subject. TEST new property. If acceptable, STORE in ACCEPTABLE SERVE PROPERTIES AND ELEMENTS and RETURN TO the main routine 4. If tentatively acceptable, RETEST. If unacceptable, GO TO 8 in the main routine.

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[a] C_1 = in front of front foot, C_2 = back over head, C_3 = out to the side, C_4 = too far in front, C_5 = right overhead; R_1 = flat, R_2 = open, R_3 = closed face of the racket; T_1 = correct height above racket, T_2 = too low, T_3 = too high.

CHAPTER VII

CONCLUSIONS

The GSPS model was revised based on the following information obtained from this study:

(1) There were some consistent patterns between subjects that could be used to model a general plan of attack. There were also a number of individual differences for which a complete learning model must account.

(2) The model was changed in the following ways: the order of reading in the main properties, CRT, was changed to TRC; the most prevalent pattern of call of properties remained the reverse pattern; however forward and mixed patterns were also used and must be included in the model. The general properties included by at least three of the six subjects were included in the model; other properties were considered individual differences.

(3) Data on speed and accuracy scores on each serve provided additional information as to the goal sought in each problem.

(4) The Verbal-Motor Behavior Graph proved to be a very good tool for analyzing verbal data, although its use was time consuming.

(5) Computer plots of motor performance, accuracy and speed scores proved to be valuable tools in comparing verbal and motor data for each subject.

(6) Most of the learning appeared to take place during the problems rather than between problems, which does not bear out the conclusion made in the first study.

(7) Learning appeared to take place as evidenced in the slow fluctuating rise of mean motor performance scores, and these rises were marked by fluctuations between high and low scores and sometimes plateaus. All these appeared to be necessary functions in the learning process. At the low scores and plateaus, the subjects were involved in complex operations. At high scores they attacked one goal or one property with a positive goal. Rises occurred after lengthy testing periods marked by transition periods and/or plateaus.

(8) Reminiscence and fatigue factors (dissipation or

cumulation) appeared to play very minor roles in the total learning picture of these six subjects.

(9) The equipment used was superior to the General Electric Tri-Pack used in the initial investigation due to its ability to still-frame. It had several drawbacks: it was heavier; the film was larger, more costly, and took more storage space; and more technical help was needed to gather and analyze the data.

CHAPTER VIII

RECOMMENDATIONS

Due to the large amount of data collected in this study, it was necessary to limit the investigation to certain variables, particularly those bearing on the development of the GSPS model. Some suggestions for study on the same data are: study of the effects of testing upon the total learning situation; an investigation of what occurs during periods of extreme anxiety or disgust as evidenced in the verbal-motor data; a study of body language in the learning situation; an analysis of what occurs in the learning pattern after one observes oneself on the television monitor; the effects of changes of weather on the learning situation.

The same type of study using the same skill could be done on similar subjects for replication purposes: on poor motor learners or ambidexterous subjects learning to perform the skill on the non-preferred side to see if differences exist between these subjects and where the differences might lie. There seems to be a large number of experiments that could be performed using this type of research design and analysis that would aid the teacher in trying to understand the learning process.

It might be possible to program the verbal data for computer analysis in order to shorten the amount of time necessary for this stage of the analysis. Some programs already exist that replicate man's solving of other types of problems.

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APPENDIX I

THE FIRST GSPS MODEL

1. READ IN Present Serve.
2. READ IN New Serve Goal.
3. COMPARE Present Serve to New Serve. Does Present Serve equal the desired improvement in the New Serve? YES. GO to 13 below. If there are differences that can be reduced, GO TO the last step executed before branching here and advance one step. If this is the first time at this step and NO, CONTINUE.
4. CALL Subgoal C (17) to reduce differences. GET next value. If values are exhausted, GO TO 15. CALL Subgoal 16.
5. APPLY property selected from C to Present Serve and see if differences are noted. If uncertain, RETEST; if no improvement or negative results GO TO 4. If improvement, GO TO 3.
6. CALL Subgoal R (18). GET next value in R. If present values of R are exhausted, GO TO 4. CALL Subgoal 16.
7. APPLY R to C. If uncertain, RETEST; if no improvement or negative results, GO TO 4. If improvement, GO TO 3.
8. CALL Subgoal T (19). GET next value in T. If values are exhausted, GO TO 6. CALL Subgoal 16.
9. APPLY T to R and note differences. If uncertain, RETEST; if no improvement, or negative results, GO TO 6. If improvement but differences still exist, GO TO 3.
10. Are there any new properties that might work? If YES, GO TO 11. If NO, are there any properties in the area called Accepted Serve Properties? If YES, GO TO Accepted Serve Properties and GET last feasible property. If NO, GO TO 8.
11. Apply property to T. Is there any improvement? If uncertain, RETEST; if negative results or no improvement, GO TO 8 and GET next property. If YES, GO TO 3. If differences still exist, GO TO 10.
12. Does acceptance of present serve indicate acceptance of a new serve property outside of C, R, and T? If YES, PUT object in storage area called Accepted Serve Properties.
13. WRITE: NEW SERVE ACCEPTED.
14. PLACE New Serve Description into Present Serve. GO TO 2.
15. WRITE: NEW SERVE REJECTED.
    STOP

---

16. Subgoal TEST VALUE. MATCH present value to past value. If present value is greater than or equal to past value RETURN to main program and CONTINUE. If less, REJECT value and TAKE next value that is higher. If none exist, RETURN this information to the main routine.
17. Subgoal C.[a] Order of Call: C2, C4, C5, C3, C1.
18. Subgoal R.[a] Order of Call: R3 or R2, R1.

19. Subgoal T.[a] Order of Call: T2, T3, T1.

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[a] C1 = in front of the front foot, C2 = back over the head, C3 = out to the side, C4 = too far in front, C5 = right over the head; R1 = racket face flat, R2 = racket face open, R3 = racket face closed; T1 = 1-3' above the height of racket, T2 = too low, T3 = too high.

APPENDIX II

SUBJECT ____________________
DATE ____________________
TIME ____________________
PAGE ____________________

SPEED-ACCURACY SCORE SHEETS

Points: 1, 2, 3, 4, 5, 6. Indicate over the rope as "O" and record the score	Zone 1, 2, 3, 4. Indicate over the rope as "O" and record the score. Record scores only if the serve went into the service court.

Serve #	ACCURACY Score	SPEED Score

APPENDIX III

INSTRUCTIONS TO THE SUBJECT (TAPED)

YOU have been selected as a subject for a study on the learning process involved in learning a tennis serve. You are working under a grant from the Department of Health, Education, and Welfare. It is very important that you follow instructions carefully and ask questions when you are not sure. The purpose of this study is for you to learn to serve as well as you can by observing a loop film (point out), looking at pictures (point out), and asking me questions. As you attempt to learn how to serve, ask yourself what you are trying to do and evaluate your results. Let me give you an example. Here is a picture of an old skill--vaulting over the horns of a bull. (Pause, show picture). How would you go about learning to do this? (STOP TAPE).

As you learn to serve, say aloud what you are trying to do, perform the serve, and evaluate the results in terms of how the serve turned out, what was wrong with it, right with it, what you are going to change, what you are going to keep, how you feel about it, things like this. You will continue this process for 7 days. The following is very important: do not discuss the serve, perform the serve, or even think about serving outside of these practice sessions. Everything you do in connection with the serve in the next seven days must be on tape! This is very important. Before you start, you will need to know a few rules concerning the serve. You must stand behind the base line between the singles sideline and the center mark (pause, demonstrate). An "X" is marked to show you an acceptable position. The serve must go diagonally to the right service court on the other side of the net. (Pause and point out). We also serve from the left side of the court into the left service court. You will not do this.

Both accuracy and speed are important. The service court is marked off into scoring areas and the highest scoring areas are in the left corner. This is where your opponent has the most difficulty in returning the serve. Also, how hard you hit the ball is important. The court is marked off into zones to show you how hard you have hit the ball by how deep the ball bounces on its second bounce, providing the serve lands in the service court. A rope is placed 4 feet over the net so that we can gather data on the results of your serves. You don't need to concern yourself unnecessarily with the rope. A good serve will go over the net; probably, but not necessarily, under the rope and into the proper service court. An assistant is recording these speed and accuracy scores on your serves but she is not observing your progress on learning the serve. The television crew will be filming everything you do and recording all that you say; however, they will not be interested in your progress on the serve either. The assistants will help you gather balls. I will answer any questions you may have and will help you run the loop film if you have any problems. However, I will not volunteer any information unless you ask for it. Feel free to look at the pictures in the books, loop film, ask questions, or to rest if you are tired. Remember, you are trying to LEARN TO SERVE and telling us about it at the same time. You will proceed at your own pace for 30 minutes. The last 10 serves each session will be test serves. We will tell you when you have 5 minutes remaining and when we will be recording test scores. We will use these in determining your personal progress from day to day. You will be left alone unless you ask for help. Do not forget to talk about what you are doing and thinking. This is important--don't be afraid to repeat the same thing over and over if that is what you are doing and thinking.

REMEMBER! Do not discuss the serve, perform the serve, or even think about serving outside these practice sessions.

Do you have any questions?

Let me demonstrate how the loop projector works.

Go right ahead then and commence to learn to serve.

*Acceptable Behavior

APPENDIX IV

MOTOR BEHAVIOR ANALYSIS

Subject________
Date________
Time & Weather________
Page________

#	GRIP	STANCE	BACKSWING	CONTACT	FOLLOW THROUGH
	*Eastern F. = G1 *Eastern B. = G2 Western = G3 *Continental = G4 Other = G5	FEET together=S1 1' apart=S2 *2' apart=S3 3' apart=S4	*Straight back as far as p. =B1 Straight back bet. B1&B3 =B2 Straight back to vertical position =B3 Back to shoulder position in forward direction =B4	*3-6" in front of front foot =C1 Back over head =C2 Out to side =C3 Too far in front =C4 Right overhead =C5	*On L. side of body by L.foot =F1 In front of L. foot =F2 At 45° angle to ground =F3 Horizontal to ground =F4 Level with shoulder =F5 At 45° angle to vertical =F6
	Racket pointing in what direction in waiting position? *Toward net = H1 Out at side of body = H2 Down toward ground = H3	SHIFT OF WEIGHT *Rock F-B-F =S5 Rock B-F =S6 No Rock B =S7 No Rock F =S8 Walks =S9 On toes =S10 Jumps =S11 Back Foot Off =S12 Foot Fault =S13 Bent Knees =S14		RACKET FACE *Flat =R1 Open =R2 Closed =R3	
	Racket held where? *At end of racket = I1 Chocking = I2	POSITION TO NET *Side to net=P1 Between P1 & P2 =P2 Facing net =P3 Other =P4	LOW POSITION ON BACKSWING *Low back =B5 Between scapula =B6 Shoulder position =B7	BALL TOSS *2-3' above height of racket =T1 Too low (elbow bent)=T2	

APPENDIX IV (continued)

GRIP	STANCE	BACKSWING	CONTACT	FOLLOW THROUGH
		Head, Ear position =B8	Too high =T3	
		ELBOW POSITION *Up by ear or higher =E1 Horizontal side (side arm) =E2 Lower than horizontal =E3 Perpendicular to body in Ft. =E4	WRIST *Hyperextended to whip =W1 Neither hyper. nor whipped =W2 Hyper. not whipped =W3 Whipped, not hyper. =W4	

APPENDIX V

VERBAL BEHAVIOR ANALYSIS (FORM)

SUBJECT________________
DATE________________
TIME________________
WEATHER________________
PAGE________________

PROBLEM________________

SERVE STATEMENT NUMBER	VERBAL PROTOCOL	CODE RULES EMPLOYED	FUNCTION	RESULT	MOVEMENT

APPENDIX VI

ABBREVIATIONS AND SYMBOLS USED IN THE FOLLOWING APPENDICES

Miscellaneous Labels

CRT	The main properties of the program. C = horizontal position of the ball toss, R = position of the racket face, and T = vertical position of the ball toss.
ELEM	Element
EXP	Exploratory phase
FOR	Forward calling of variables, properties and elements starting with the primary ones accepted
MIX	Mixed order of calling variables
NC	No verbal data
NEG	Negative goal or negative solution to the problem
POS	Positive
PROP	Property
REV	Reverse order of calling variables, properties and elements; starting with the most recent ones accepted
STR	Straight
V	Value
VAR	Variable

Properties and Elements Read In By The Subjects

ACC	Accuracy
AGGR	Aggressive
ANG	Angle
ARM	Moving arm across body
B	Backswing
BAL	Balance
BNG DOWN	Bring Down
BNG UP	Bring up
C	Horizontal position of the ball toss
COMF	Comfortable
CON	Control
CONT	Contact
COOR	Coordination
DOA	Down off arm
DR	Drop racket
E	Elbow position, arm position (curved or straight)
EYES	Eyes on the ball
F	Follow through
FB	Follow ball in the air
FOB	Finger on the back of the racket
FS	Forward swing
G	Type of grip
G_t	Grip tighter
H	Starting position

APPENDIX VI (continued)

HD	Hit down
H_{di}	Hit diagonally
HU	Hit up
HS	Higher swing
I	Choke racket
LEV	Lever--shorter, longer forearm
MB	Move body
MF	Move faster
ML	Move less
MOC	Move on the court
MOM	Momentum
NER	Nervous, relax
OC	Off center or on center of the racket
OT	On toes
P	Starting position, body position
PEN	Pendular motion
PP Idea	Ping-pong concept
PR	Practice
R	Position of the racket face, racket head
RCH	Reach
RCM	Continuous motion, roundness
RHY	Rhythm
RS	Swinging racket
RW	Racket weight, change rackets
S_1	Foot position, stance
S_9	Walks, feet still, foot action
S_{13}	Foot fault
S_{14}	Bent knees
S_{15}	Step back
SIM	Simultaneously toss and swing
SLB	Swing like a baseball
SM	Smash
SPD	Speed
T	Vertical position of racket face (toss higher, lower, etc.)
T_i	Thumb in
TIM	Timing
TK	Think, concentrate
TOP	Hit on the top of the ball, come over the top of the ball
W	Wrist flexed, hyperextended positions
W_h	Wrist abducted, adducted positions
WA	Whole arm
WB	Whole body
WS	Whole stroke
WU	Warmup

APPENDIX VI (continued)

Operations Performed by Subjects In Solving the Problem

+	Add variables, properties or accept solution
A	Apply
A/E	Assign equivalency
A/V	Assign value
C	Call
CO	Compare
↓	Decrease
EVAL	Evaluate
F	Find
↑	Increase
ND	Narrow down search
R	Read in
↔	Remain the same
RET	Return
S	Select
-	Subtract variables or properties, or negative solution to the problem, reject the serve
ST	Store
?	Tentative accept the solution or serve
W	Write

Key to Solution Codes for Problems

1. ? Tentatively accept
2. - Reject serve and solution
3. + Accept serve and solution
4. -+ Reject serve, accept solution
5. +- Accept serve, reject solution
6. TR Transition period (more than 3 serves at the beginning or end of a problem without verbal comment)
7. TEST Testing (Hewitt serve tests).

APPENDIX VII

Subject 1: HEWITT SERVE TEST SCORE ANALYSIS

Day	Raw Accuracy Score	Raw Speed Score	T-Score Accuracy	T-Score Speed
1	7	4	60	53
2	0	0	35	38
3	9	9	64	68
4	8	12	63	75
5	4	3	53	51
6	2	3	48	51
7	12	11	69	70

APPENDIX VIII

Subject 1: ACCURACY-SPEED MEAN DAILY SCORES

Day	#of Serves	Raw Accuracy Score	Raw Speed Score	Mean Accuracy	Mean Speed
1	51	30	34	.59	.67
2	90	34	26	.38	.29
3	117	61	65	.52	.56
4	111	72	79	.65	.71
5	88	37	39	.42	.44
6	94	75	74	.82	.80
7	42	37	37	.88	.88
Totals..	593	346	354	4.26	4.35

Average mean accuracy = .61
Average mean speed = .62

*2 scores missing; 10 numbered incorrectly -- 605 serves (actually 593 with accuracy and speed scores.)

APPENDIX IX

ORDER SUBJECT 1 READ IN VARIABLES, VALUES, PROPERTIES AND ELEMENTS

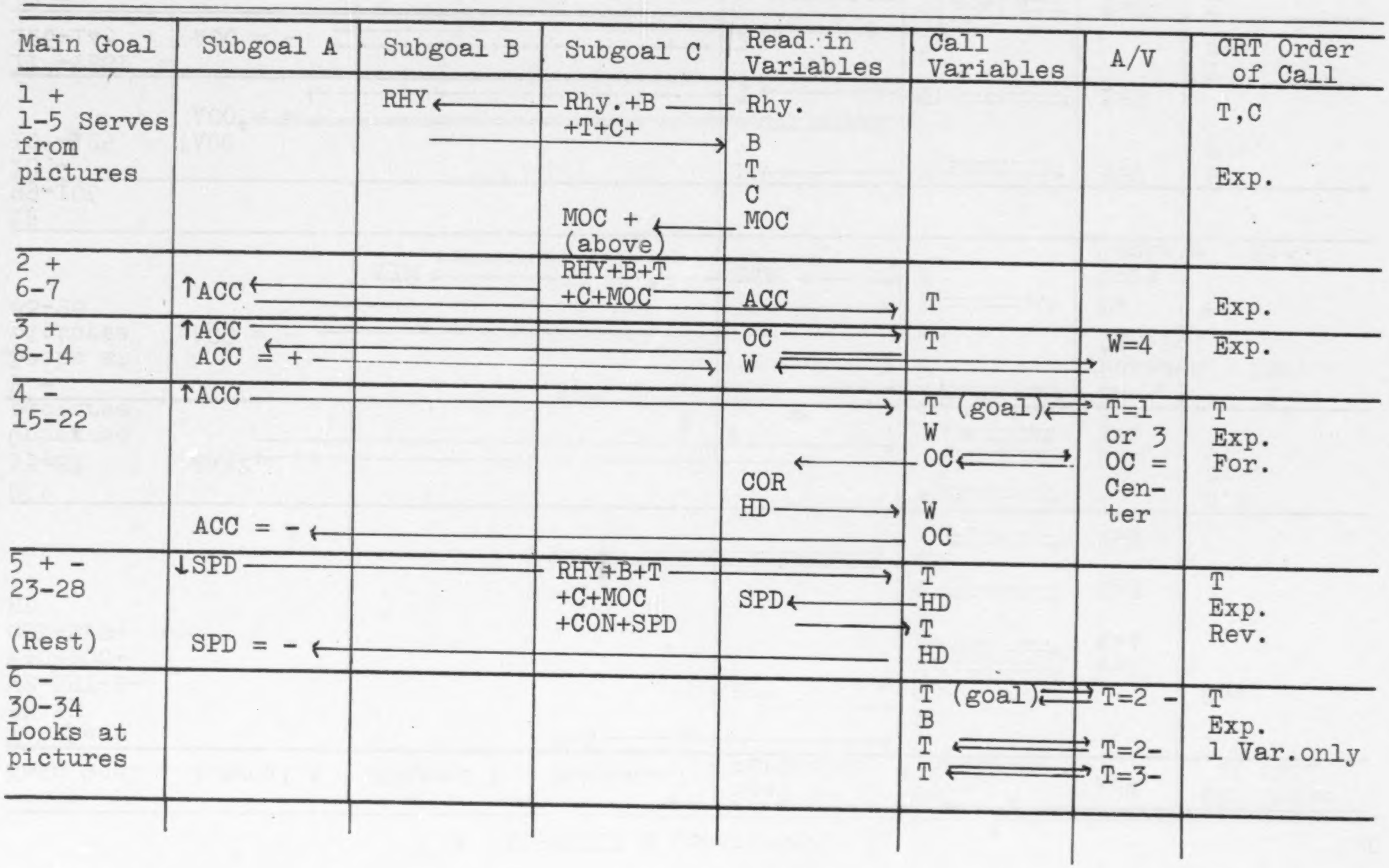
1. RHY = rhythm
2. B = armswing back
3. T = toss
4. C = hit ball
5. MOC = move on court
6. ACC = accuracy
   (T = highest point "peak", A/V)
7. W = slam down, snap wrist
8. OC = off center, -
   (on center, A/V,+)
9. HD = hit down
   (W_4 = wrist straight, A/V)
10. SPD = speed, force
    (T_2 = toss too low; A/V,-)
    (T_3 = toss too high; A/V,-)
11. H. DIAG. = Hit diagonally; +,-
    (W_2 = accepts wrist snap; -; see 7, 12)
    (C_3 = A/V;+)
    (W_H = wrist twisted horizontally, A/V,-)
    (C_1 = toss out in front, A/V,+)
12. SIM = simultaneously toss and swing
    (B = rounded circle behind, A/V,+)
    (T = T_1 or T_3 toss higher, A/V,+)
13. TIMING = too late, A/V,+)
14. R = hit up, A/V,+
15. I_2 = choke racket, A/V,+
16. E = racket head lower
    (T_2 = toss lower, A/V,+)
    (T_2 = -)
17. THINK
18. RCH = reach, +
19. WB = whole body, +
20. S_9 = stepping
    (HD = hit down, -, accepted in 11)
    (C_4 = too far in front, -)
21. F = full swing down, +
    (R_1 = straight hit, A/V,+)
    (C_3 = out to the side, A/V,-)
22. "Ping Pong" concept, -
    (B_4 = bring racket back to shoulder in forward position, A/V,-)

APPENDIX IX (continued)

23. WA = whole arm, +
24. TOP = on top of the ball
    (T = level of racket, A/V)
25. G = lost hold of the racket, A/V,-
    (Timing = hold ball too long, A/V,-)
    (R_2 = going up, +?)
26. WARMUP = +
27. WIND = -, + as harmful

APPENDIX X

Subject 1: VERBAL-MOTOR BEHAVIOR GRAPH



Main Goal	Subgoal A	Subgoal B	Subgoal C	Read in Variables	Call Variables	A/V	CRT Order of Call
1 + 1-5 Serves from pictures		RHY	Rhy.+B +T+C+ MOC + (above)	Rhy. B T C MOC			T,C Exp.
2 + 6-7	↑ACC		RHY+B+T +C+MOC	ACC	T		Exp.
3 + 8-14	↑ACC ACC = +			OC W	T	W=4	Exp.
4 - 15-22	↑ACC ACC = -			COR HD	T (goal) W OC W OC	T=1 or 3 OC = Center	T Exp. For.
5 + - 23-28 (Rest)	↓SPD SPD = -		RHY+B+T +C+MOC +CON+SPD	SPD	T HD T HD		T Exp. Rev.
6 - 30-34 Looks at pictures					T (goal) B T T	T=2 - T=2- T=3-	T Exp. 1 Var.only

APPENDIX X (continued)

Main Goal	Subgoal A	Subgoal B	Subgoal C	Read in Variables	Call Variables	A/V	CRT Order of Call
7 ? Test			T=B		T		T,C
35-53					B		
WS=RHY+B+				HD	OC		Rev.
T+C+MOC+					W	W=2	
CON+SPD+					W	W=4	
HD					B		
					C	C=3	
			HD+WH		HD		
					W_H	W=H	
8 ?					W_4	-	C,T
53=87	A=B?				C	C=1	Exp.
Observes pictures					T	T=1	For.
9 -			B+T	SIM	B	B=	T
Looks at					W_2	Rounded	For.
pictures	ACC = -				OC	Circle	
88-98					T	T= -	
		TIM		TIM	W_2	1or3	
						Toolate	Rev.
TR							
99-106							
10 -				R	W_h	R=2	R
107-125	↑ACC						For.
	ACC = -				C_3		
				I	HD	I=2	
11 -TEST							T
126-143	ACC = -			E	T_2		Exp.
12 = -					T(goal)	T=2-	T
144-178		THINK		TK		T-1+	Rev.
(disgust)	↑ACC				HD		
					W_2		

APPENDIX X (continued)

Main Goal	Subgoal A	Subgoal B	Subgoal C	Read in Variables	Call Variables	A/V	CRT Order of Call
TR 179-193		THINK					
13 - 194-213 "can't get whole thing down"	ACC = - ← →			RCH →	B HD W T ⇄ HD	T=3-	T Rev.
14 + 214-247	↑ACC ←		B+T-HD + ← C+W →	WB → S_9 →	B T HD T_2 ⇄ C_4 ⇄ W_h T	T=2- C=4-	T,C Mix.
15 + Test 248-260			HD+F+ FULL SWING ← →	F	C ⇄ T ⇄ HD C_4 T ⇄ T ⇄	C=4- T=1+ T=2- T=1+	C,T Only 1 Var.
16 + Test 248-260	ACC ←				T_1 I_2 W_2 T_2 W_2 T_1 R ⇄ W_4	R=1+	T,C,R Rev.

APPENDIX X (continued)

Main Goal	Subgoal A	Subgoal B	Subgoal C	Read in Variables	Call Variables	A/V	CRT Order of Call
17 + 304-325					C_4		
					W_4		
	ACC ←	←	←	←	T_3		
	→	→	→	→	R_1		
					OC		
					T_3		
	SPD ←	←	←	←	W_4		
	→	→	→	→	WB		
					C_4		
					T_2		C,T,R For.
					W_4		
					C_4		
					T_3		
	↑ACC/SPD ←	←	←	←	T_1		
18 + 326-336					HD		
				"Ping- ←	C_3 ⇄	C=3-	C,T Rev.
				pong →	T_2		
				concept	C_4		
					T_2		
					W_4		
					W_1		

APPENDIX X (continued)

Main Goal	Subgoal A	Subgoal B	Subgoal C	Read in Variables	Call Variables	A/V	CRT Order of Call
19 + - 337-357	ACC			→	ACC		
					Ping-pong		R,T,C
					R_1		
					I_2		
					W_1		
					T_2		
					WB		
	ACC = =			←	T_2		Mix.
				→	R_1		
	ACC = -			←			
				→	T_2		
					B		
					T_2		
	ACC = -			←	WB		
				→	T_2		
	ACC = -			←	C_4		
				→	T_2		
20 + 358-371	ACC			←	W_4 (goal-·) ⇄	W=4-	T
				→	ACC		
					T_3		
					B ⇄	B=4-	
	SPD			←	T_2		
				→	SPD		
			WB+S	←	WB		
				→			

APPENDIX X (continued)

Main Goal	Subgoal A	Subgoal B	Subgoal C	Read in Variables	Call Variables	A/V	CRT Order of Call
					S_9		
					OC		
	ACC/SPD + ←				W_4 ⇄	W=4-	Mix
	→				→ W_2 ⇄	W=2+	
	ACC/SPD ←	TIM ←					
	→				→ TIM		
					WB		
21 - Test 372-381	SPD →				→ T_2		T,C
	←				WB		
	→				→ W_h		Rev
					C_4		
22 - 382-395	SPD ←		W_h+WB=SPD ←		W_2		T
	→				→ WB		Mix
					SPD		
					T_2		
					WB		
					T_2		
					HD		
				WA ←	T_2		
				→	→ T_1		
					W_2		
23 - 396-405					HD		T,R
					T_2		Rev. skips
					W_2		
					R_1		
	ACC = - ←				→ W_h ⇄	W_h=-	

APPENDIX X (continued)

Main Goal	Subgoal A	Subgoal B	Subgoal C	Read in Variables	Call Variables	A/V	CRT Order of Call
24 + 406-416	↑ACC →	→	→	→	T_1		T Rev.
				OT ←	WA		
				→	HD		
25 - 417-423					HD		
	ACC = - ←	←	←	←	I_2		
	→	→	→	→	W		T Mix
					F		
					HD		
	ACC = - ←	←	←	←	T_2		
	→	→	→	→	W_2		
26 + 424-436					HD		R,T Mix
					B		
					R_1		
					W_h		
			T_1 + HD ←	←	T_2		
			→	→	HD		
					T_1		
27 - + 437-439		RHY →	→	→	RHY		C Mix
			RHY + F ←	←	F		
			→	→	C		
					W_2		
	ACC/SPD=+ ←	←	←	←	HD		
	→	→	→	→	SPD		
					ACC		
		TIM ←	TIM + W ←	←	W_2		

APPENDIX X (continued)

Main Goal	Subgoal A	Subgoal B	Subgoal C	Read in Variables	Call Variables	A/V	CRT Order of Call
28 + 440-449					W_h		
					HD		T
					T_2		Mix
					OC		
					HD		
					W_2		
			T + W ←	←	T ⇄	level	
			→	→	W_2	of	
						racket	
29 + 450-463			TIM + W ←	←	TIM ⇄	TIM	
			→	→	W_2	too	For.
					HD	late	
					W_2	sooner	
					W_h		
					W_2 ⇄	str- aight	
30 ?Test 464-469					T_2		T
					W_4 ⇄	flat-	For.
					HD		
					W_2		
31 - 470-480			T + W_2 + SPD + B ←	←	T		
			→	→	W_2		T
					SPD		
	ACC = - ←	←	←	←	B		Mix
	→	→	→	G →	W_h ⇄	let go-	
				HB ←		HB=-	

APPENDIX X (continued)

Main Goal	Subgoal A	Subgoal B	Subgoal C	Read in Variables	Call Variables	A/V	CRT Order of Call
32 - 481-496	SPD ——	——	——	——→	SPD		T Rev.
					OC		
					T_2		
					T_3		
	SPD - ←——	——	——	——	W_2		
	——	——	——	——→	T_2		
	SPD - ←——	TIM ——	——	——	W_2 ——→	TIM= too soon	
33 - + 497-501					W_h		T,R For.
					T		
			T + W + R ←	——	W_2		
				——→	R		
	ACC ←——	——	ACC + R ——	——	ACC		
	——	——	——	——→	SPD		
					I_2		
					G		
34 + 502-526	↑SPD	TIM ←——	——	——	SPD		T Mix
	↑ACC = + ←——	——	——	——→	TIM ←——→	TIM= too late	
	↑SPD ——	——	——	——→	ACC		
					W_2		
					W_h		
	SPD = + ←——	——	——	——	T_2		
	——	——	——	——→	W_h		
					W_2		
					W_h		
					W_2		
					TGoal		

APPENDIX X (continued)

Main Goal	Subgoal A	Subgoal B	Subgoal C	Read in Variables	Call Variables	A/V	CRT Order of Call
35 + 527-535					W_h		
					B		
					T_1		T,R
					W_2		
					T_1		
					W_2		
					R_1		
		TIM ←	TIM + W_2 ←	←	W_2		
		→	+ T →	→	W_4		Mix
					W_2		
					TIM		
					T_1		
36 - 536-563	ACC = + ←	←	←	←	T_2		T,R For.
	→	→	→	→	W_h		
					HD		
					R_2		
					T_2		
	ACC = - ←	←	←	←	W_2	⟷ Off to R.	
	→	→	→	→	W_4		
					T_2		
					W_2		
whole serve = - ← "Oh dear"	← ACC = +"OK" ←	←	←	←	T		
					W_4		

APPENDIX X (continued)

Main Goal	Subgoal A	Subgoal B	Subgoal C	Read in Variables	Call Variables	A/V	CRT Order of Call
37 - 564-593 watches loops					W_2		T,C
				⟵	T_2 ⇄	T=2+	For
				WARM UP ⟶	C_4		
				WIND ⟵	C_4		
				⟶	WIND		
					W_2		
					WIND		
					G ⇄	G=lost	
					T_2		
					G ⇄	G=lost	
					W_2		
					W_h		
	ACC = - ⟸				WIND ⇄	sliced to R.	
					C_1(goal) ⇄	C=1+	
38 +Test 594-605					T_2		T,R
					W_2		For.
					OC		
					W_2		
					T_2		
					W_2		
					R_1		

APPENDIX XI

Subject 1: SYNOPSIS OF VERBAL-MOTOR BEHAVIOR GRAPH

-	- +		?	+	+ -
CRT	Order of Call	CRT	Order of Call	CRT	Order of Call
4. T	For	7. T,C	Rev	1. T,C	-
6. T	Only 1 Var.	8. C,T	Only 1 Var.	2. T	-
9. T	For	30. T	For	3. T	-
10. R,C	For			5. T	Rev.
11. T	-			14. T,C	Mix
12. T	Rev.			15. C,T	Only 1 Var.
13. T	Mix.			16. T,C, R	Rev.
21. T,C	Rev.			17. C,T, R	For
22. T	Mix, Rev.			18. C,T	Rev
23. T,R	Rev.			19. R,T, C	Mix
25. T	For			20. T	Mix
27. C	Mix			24. T	Rev
31. T	Mix			26. R,T	Mix
33. T,R	For			28. T	Mix
36. T,R	For			29. -	For
37. T,C	For			34. T	Mix
				35. T,R	Mix
				38. T,R	For
TOTALS T =10 TC = 2 TR = 3 RC = 1 C = 1	For=7 Rev=4 Mix=4	TC=1 CT=1 T =1	For=1 Rev=1	T = 7 TC = 2 TR = 2 RC = 0 C = 0 CT = 2 CTR= 1 TCR= 1 RTC= 1 RT = 1	For=3 Rev=4 Mix=7

APPENDIX XII

Subject 1: ANALYSIS OF VERBAL PROBLEMS BY MOTOR PLOT SCORES

Problem	Episodes	#Episodes	Sol. Code[a]	Range of Scores[b]	Motor Plot Total Score	Initial Score	Final Score	Mean Score
1	1-5	5	3					
2	6-8	3	3					
3	9-14	6	3	26-39	202	38	31	33.16
4	15-22	8	2	28-39	268	39	38	33.50
5	23-28	6	5	33-55	252	33	43	42.00
6	29-34	6	2	36-44	245	44	44	40.83
7	35-52[c]	18	1,7	31-54	785	44	47	43.61
8	53-87[d]	35	1	24-50	1411	40	49	40.31
9	88-98	11	2	31-49	467	37	42	42.45
TR	99-106	8	6	27-45	308	36	43	38.50
10	107-125	19	2	32-55	822	47	43	43.26
11	126-143	18	2,7	36-59	893	59	39	49.61
12	144-178	35	2	29-55	1580	29	46	45.14
TR	179-193	15	6	40-52	683	52	40	45.54
13	194-213	20	2	34-52	935	40	38	46.75
14	214-247	34	3	30-52	1585	46	52	46.62
15	248-260	13	3,7	38-52	614	46	40	47.23
16	271-303[e]	33	3	34-52	1474	52	40	44.67
17	304-325	22	3	37-52	1006	46	40	45.72
18	326-336	11	3	29-52	480	52	46	43.63
19	337-357	21	5	34-52	1000	52	46	47.62

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[a] See Appendix VI for the legend of these codes.
[b] No motor plot score for episodes 1-8.
[c] No motor score for episode 42.
[d] No accuracy-speed scores for serve 53.
[e] Serves 261-270 non-existent: numbered incorrectly.

APPENDIX XII (continued)

Problem	Episodes	#Episodes	Sol. Code[a]	Range of Scores[b]	Motor Plot Total Score	Initial Score	Final Score	Mean Score
20	358-371	14	3	40-52	673	52	46	48.07
21	372-381	10	2,7	40-55	470	52	55	47.00
22	382-395	14	4	37-55	637	40	40	45.50
23	396-405	10	2	36-52	422	46	37	42.20
24	406-416	11	3	31-52	469	31	52	42.63
25	417-423	7	2	33-52	296	37	52	42.29
26	424-436	13	3	37-52	578	37	46	44.46
27	437-439	3	4	37-52	129	37	52	43.00
28	440-449	10	3	37-52	451	52	46	45.10
29	450-463	14	3	40-52	628	45	41	44.86
30	464-469	6	1,7	40-52	272	48	40	45.33
31	470-480	11	2	34-52	516	37	52	46.91
32	481-496	16	2	30-52	631	46	31	39.44
33	497-501	5	4	43-48	229	43	46	45.80
34	502-526	25	3	39-52	1095	39	40	43.80
35	527-535	9	3	40-52	432	40	46	48.00
36	536-563	28	2,7	34-52	1223	46	46	43.67
37	564-593	30	2	30-52	1384	44	46	46.13
38	594-605	12	3,7	40-52	593	52	52	49.41

APPENDIX XIII

Subject 1: ANALYSIS OF HIGHEST SCORES DURING EACH PROBLEM

Problem	Episode	Score	Analysis of Verbal Data Around Highest Score	Result
3	10	39	W_4 "My wrist has to stay straight."	+
4	15,19	39	goal: hit ball at peak	+
5	25	55	goal: hit at peak + HD combin. 2 goals	-
6	29,30,34	44	working on T	?
7	48	54	Incomplete sentence: "I left that ...."	?
8	68,69	50	NC	-
9	95	49	prior goal T 3 or T1. NC	-
TR	102,3	45	TR per. NC (98) working on TIM	
10	114	55	"did it sideways," tossed to side	-
11	126	59	"racket head lower" "I can't tell what that little difference is"	?
12	155,6	55	goal: toss higher positive goal	+
TR	179,192	52	goal: wrist snap (178)	+
13	198-202	52	plateau, goal (195) backswing, combining elements	+
14	scattered	52	plateau, backswing + T + HD, combining elements	-
15	scattered	52	plateau, whole thing: whole body, B + T + S_9 + W_h + C, combining elements	
16	scattered	52	T + G + W + C + straight, combining elements plateau	
17	313-322	52	T=too low, "C=too far in front"	-
18	326,331	52	plateau, "Swing down on it" RCH + C + HD + Racket straight, combination	+
19	scattered	52	plateau, combining of elements: racket st. + G + W + T + WB + B + C	
20	scattered	52	W + T + B + SPD + S_9 + OC + W straight; combining of elements into whole serve with proper timing "Oh good"	+
21	381	55	"Nope, I just serve that way" WS	-?
22	388,390	55	NC, "I just come down with my wrist," accomplished goal	+
23	403	52	statement of goal: W in 398,401; 403 NC	+

APPENDIX XIII (Continued)

Problem	Episode	Score	Analysis of Verbal Data Around Highest Score	Result
24	410,423, 416	52	goal: armswing	+
25	422,423	52	"Must be hitting them too low" Goal=T + W, Acc = -; ND to 2 elements	-
26	scattered	52	plateau, HD + B + W + T + HD = T_1 + HD ND goal	Narrows goal
27	439	52	"snapped wrist too soon; darn it"	-
28	440,441	52	"twisted my wrist, it went straight down"	-, +
29	454/459	52	"snap it sooner, hit down," HD + W, narrows goal, combining of properties	+
30	467	52	"Come down," accomplished goal	+
31	454-480	52	plateau still, G + W + TIM, combining of properties	-
32	482,484	52	NC, goal = SPD + TIM, combining elements into larger goals	
33	499	48	NC, goal = wrist snap + T + ACC + SPD + G, combining	
34	scattered	52	plateau still, TIM + SPD + W. combining of elements	
35	scattered	52	plateau, "twisting W, W snap."	+
36	scattered	52	plateau, W	+
37	scattered	52	W	+
38	scattered	52	T + W + TIM + hand straight, combining of elements	

APPENDIX XIV

Subject 1: INCREASES AND DECREASES IN MOTOR PERFORMANCE SCORES WITHIN AND BETWEEN DAYS

Days	Increases	Decreases	Scores Remaining the Same	Total
Between	1 (16.66%)	5 (83.33%)	0 (00.00%)	6
Within	15 (46.87%)	12 (37.50%)	5 (15.62%)	32
Total	16 (42.10%)	17 (44.73%)	5 (13.15%)	38

APPENDIX XV

Subject 1: THE EFFECTS OF REST UPON THE WITHIN DAY INCREASES AND DECREASES OF MOTOR PERFORMANCE SCORES

Increases with Rest	Increases Without Rest	Decreases With Rest	Decreases Without Rest	Stays Same With Rest	Stays Same Without Rest	Total
5 (15.62%)	10 (31.25%)	3 (9.37%)	9 (28.12%)	0 (0.00%)	5 (15.62%)	32
Total	15 (46.88)		12 (37.50)		5 (15.62)	32

APPENDIX XVI

Subject 1: ANALYSIS OF VERBAL PROBLEMS BY ACCURACY/SPEED SCORES

Problem	#Episodes	Raw Score Accuracy	Raw Score Speed	Accuracy Ratio (6 max)	Speed Ratio (4 max)	Sol.	Code[a]
1	5	1	2	.20	.40	+	3
2	3	2	2	.66	.66	+	3
3	6	8	9	1.33	1.50	+	3
4	8	8	12	1.00	1.50	–	2
5	6	3	3	.50	.50	+–	5
6	7[b]	1	2	.14	.29	–	2
7	17[b]	7	4	.44	.24	?	1,7
8	34[b]	11	10	.32	.29	?	1
9	11	1	1	.09	.09	–	2
TR	8	6	2	.75	.25	TR	6
10	20	12	8	.60	.40	–	2
11	18	4	5	.22	.28	–	2,7
12	35	8	12	.23	.34	–	2
TR	15	3	4	.20	.27	TR	6
13	20	12	13	.60	.65	–	2
14	33	29	27	.88	.82	+	3
15	13	9	9	.69	.69	+	3,7
16	33	28	23	.85	.70	+	3
17	22	13	10	.59	.45	+	3
18	11	2	3	.18	.27	+	3
19	21	15	23	.71	1.10	+–	5
20	14	6	8	.43	.57	+	3
21	10	8	12	.80	1.20	–	2,7
22	14	4	5	.29	.36	–	2
23	10	0	0	.00	.00	–	2
24	11	3	4	.27	.36	+	3
25	7	0	0	.00	.00	–	2
26	13	15	12	1.15	.92	+	3
27	3	2	2	.67	.67	–+	4
28	10	4	5	.40	.50	+	3
29	14	5	8	.36	.57	+	3
30	6	4	3	.67	.50	?TEST	1,7
31	11	4	5	.36	.45	–	2
32	16	21	15	1.31	.94	–	2
33	5	3	2	.60	.40	–+	4
34	25	21	16	.84	.64	+	3
35	9	5	7	.56	.78	+	3
36	28	21	29	.71	1.04	–	2,7
37	30	25	26	.83	.87	–	2
38	12	12	11	1.00	.91	+	3,7

[a] See Appendix VI for the key to solution codes.

[b] Episodes 42 and 53 have no accuracy/speed scores.

APPENDIX XVII

Subject 1: INCREASES AND DECREASES IN ACCURACY AND SPEED SCORES WITHIN AND BETWEEN DAYS

ACCURACY

Days	Increases	Decreases	Scores Remaining the Same	Total
Between	1 (16.66%)	1 (16.66%)	4 (66.66%)	6
Within	8 (24.24%)	1 (3.03%)	24 (72.72%)	33
Total	9 (23.07%)	2 (5.12%)	28 (71.79%)	39

SPEED

Days	Increases	Decreases	Scores Remaining the Same	Total
Between	1 (16.66%)	1 (16.66%)	4 (66.06%)	6
Within	9 (27.27%)	1 (3.03%)	23 (69.69%)	33
Total	10 (25.64%)	2 (5.12%)	27 (69.23%)	39

APPENDIX XVIII

Subject 1: THE EFFECTS OF REST UPON THE WITHIN-DAY INCREASES AND DECREASES OF ACCURACY AND SPEED SCORES

ACCURACY

Increase With Rest	Increase Without Rest	Decrease With Rest	Decrease Without Rest	Stays Same With Rest	Stays Same Without Rest	Total
2 (6.06%)	6 (18.18%)	0 (0.00%)	1 (3.03%)	7 (21.21%)	17 (51.51%)	33
Total	8 (24.24%)		1 (3.03%)		24 (72.72%)	33

SPEED

Increase With Rest	Increase Without Rest	Decrease With Rest	Decrease Without Rest	Stays Same With Rest	Stays Same Without Rest	Total
1 (3.03%)	8 (24.24%)	1 (3.03%)	0 (00.00%)	4 (12.12%)	19 (57.57%)	33
Total	9 (27.27%)		1 (3.03%)		23 (69.69%)	33

APPENDIX XIX

Subject 2: HEWITT SERVE TEST SCORE ANALYSIS

Day	EPS	Raw Accuracy Score	Raw Speed Score	T-Score Accuracy	T-Score Speed
1	59-68	10	6	65	60
2	149-158	8	7	64	63
3	226-235	18	10	80+	69
4	361-370	19	8	80+	66
5	440-449	6	5	58	58
6	586-595	11	6	67	60
7	630-639	12	5	69	58

APPENDIX XX

Subject 2: ACCURACY-SPEED MEAN DAILY SCORES

Day	#of Serves	Raw Accuracy Scores	Raw Speed Score	Mean Accuracy	Mean Speed
1	67	58	42	.87	.63
2	91	75	51	.82	.56
3	78	86	54	1.10	.69
4	134	96	68	.72	.51
5	79	61	43	.77	.54
6	146	114	80	.78	.55
7	44	32	19	.73	.43
Total	639	522	357	5.79	3.91

Average daily accuracy = .82
Average daily speed = .56

APPENDIX XXI

ORDER SUBJECT 2 READS IN VARIABLES, PROPERTIES AND ELEMENTS

1. T = TOSS
    (T=2 too low, A/V,-)
2. R = racket not low enough, A/V, +)
3. SPD
4. ACC
5. S_9 = walks, +
    (C_3 = toss out to the side, A/V,-)
    (T = 1 or 3, A/V, +)
6. S_{14} = bent knees, +
7. W_h = wrist turned horizontally, hit diagonally, +
8. F = follow through
9. LEAN = lean to the left, A/V, -
10. P_1 = not standing to side enough, +, -
11. G = grip firm, +
12. TIM = timing = too late, A/V, +
    (R = too much curve, not enough curve, A/V -- R and L)
    (R = straight, A/V, +)
    (R = 1 racket down straight or completely straight, A/V, +)
13. E = drop racket, +
14. HD = brought it down, +
15. CONT = contact
16. W_2 = slapped down
17. S_{13} = foot fault, -; related to S_9, + before)
18. WB = whole body, lean into it, +
19. SIM = simultaneously toss and swing, +
20. B_1 = fuller backswing, +
    (P_3 = facing net, A/V, +)
    (H_1 = racket pointing toward net, A/V, +)
    (C_2 = toss back over head, A/V, -)
    (P = point backward toe, A/V, +)
21. OC = off center, -
    (C_4 = A/V, -)
22. RS = swinging racket too much, swing less, A/V, +)
    (RS = not swinging up high enough, swing higher, A/V,+)
23. E = sidearm, A/V = E = 2
    (LEAN = lean to the right, lean to the left, A/V)
24. CON = control over the racket, +
25. RCH = reach out, +
26. TOP = on top of the ball, +
27. BNG UP = come up with the head of the racket, +

APPENDIX XXI (continued)

28. ARCH = bend the body, +
    (T = 1, A/V, +)
29. WIND = -
    (C = 1, A/V, +)
    (G = 1, A/V, +)

APPENDIX XXII

Subject 2: VERBAL-MOTOR BEHAVIOR GRAPH

Main Goal	Subgoal A	Subgoal B	Subgoal C	Read in Variables	Call Variables	A/V	CRT Order of Call
1 + 1-3	↑SPD(goal) ←			T_2 ⇄ R_2 T(goal) ⇄ SPD		high enough low enough T=1 or 3	Explor.T,R
2. +- 4-8	↑ACC → ACC = - ←			ACC S_9 ⇄ C_3 ⇄	ACC	C=3	Exp. C
3. + 9-13				S_{14} ←	T_2 ⇄ T_1	T=2, 1 or 3?	T Exp.
4. + 14-17	↑ACC ← ↓SPD		T_3=SPD ← ACC		T_3 ⇄ SPD ACC	T=3+	T Exp. For
5. + 18-19	↑ACC ←			F	W_h S_9 ACC		Exp. Rev
6. + 20-23	↓SPD ↑ACC ← ACC = + →				SPD ACC T F		T For
7. - 24-33	↓SPD ACC = - ⇄			LTL	T_3 ⇄ SPD W_h ⇄	T=3- W=h	T Mix

APPENDIX XXII (continued)

Main Goal	Subgoal A	Subgoal B	Subgoal C	Read in Variables	Call Variables	A/V	CRT Order of Call
	ACC = − ⇄	⇄	⇄	⇄	ACC T_3		
	ACC = + →	→	→	P_1 →			
	ACC = − ←	←	←	←	P_1 ⇄	P=1-	
8. − 34-41	ACC = + ACC = − →	→	→	→	ACC P_1		Rev
	ACC = − ←	←	←	←	S_{14}		
9. − Test 42-67	↓SPD →	→	→	→	SPD		T For
	ACC = +			G ⇄	ACC T_2		
10. +- 68-75	ACC = + ⇄	⇄	⇄	⇄	T_2 LTL		T Mix
	ACC = − ⇄	⇄	⇄	⇄	ACC W_h		
	ACC = + ←	←	←	←	ACC LTL		
	—	TIM →	→	TIM ⇄	⇄	TIM= too late	
				→	F		
11. + 96-85					LTL		
	ACC = + ←	←	←	←	R ⇄ T_3 ⇄	R=4 cur-ved	Exp. R,T
	↓SPD ACC = + →	→	→	→	ACC SPD		
	ACC = + ⇄	⇄	⇄	⇄	R_4 F		Rev

APPENDIX XXII (continued)

Main Goal	Subgoal A	Subgoal B	Subgoal C	Read in Variables	Call Variables	A/V	CRT Order of Call
	ACC = +				R_4		
looks at					R_1		
pictures					R_4	R=1	
12. -+	ACC = +			E	R_4	Bg.	R,T
86-90						head	
	ACC = +				HD	of rac-	
	ACC = -				HD	ket	
						down	
					R	R=3	
					T_2	closed	Rev.
13. ?		TIM		C	TIM	-	C,R,T
91-99							
	ACC = +		R + C		HD		Rev
	ACC				R_4	R=4	
	ACC = +						
					S_{14}		
			S_{14} + HD		HD		
					R_4		
			$R_2 + T_3$				
	ACC = -				T_3		
	ACC = +			W		W=2	
	ACC = -				P		
					R_1		
					LTL	+	
			$R=R_1 + LTL-R_4$		R_4	-	

APPENDIX XXII (continued)

Main Goal	Subgoal A	Subgoal B	Subgoal C	Read in Variables	Call Variables	A/V	CRT Order of Call
14. + 100-106	ACC = -				ACC		T,R For
	ACC = + →	→	→	→	R_4		
	ACC = + ←	←	←	←	T_3		
	→	→	→	→	R_4		
		TIM ⇄	⇄	⇄	TIM ⇄	TIM= too late	
	ACC = + ⇄	⇄	⇄	⇄	W ⇄	W-dropping it down	
	ACC = + ⇄	⇄	ACC=-S_{13} ⇄	S_{13} ⇄	⇄	S=13-	
15. - 107-126	ACC = + ←	←	←	←	S_{13}		
	ACC = - ⇄	⇄	⇄	WB ⇄	ACC		T,R
	ACC = - ⇄	⇄	⇄	⇄	T_2		Mix
	←	←	←	←			
	ACC = - →	FEEL →	→	FEEL ⇄	⇄	good	
	ACC = - ←	←	←	←			
	ACC = - →	→	→	→	LTL		
					S_{13}		
			P + R_3 ⇄	⇄	P ⇄	P=1	
					HD		
					R_3 ⇄	R=3?	
					R_4 ⇄	R=4?	
					R_1 ⇄	R=1?	
					R_4 ⇄	R=4?	
					R_4 ⇄	R_4=L R_4=R	

APPENDIX XXII (continued)

Main Goal	Subgoal A	Subgoal B	Subgoal C	Read in Variables	Call Variables	A/V	CRT Order of Call
						R_4=L	
looks at pictures	ACC = - ←				R_3 ⇄	R=3+	
	ACC = - →				HD		
16. ? 127-134			H + SIM ←	H ←	T		T,R,C Mix
			SIM=T + B →	SIM			
				B →	F ⇄	B=fuller backswing	
					HD		
					C		
	ACC = + ⇄				P_1 ⇄	P=1-	
	ACC = - ←				S_{13}		
	ACC = + →		P = ACC →		P_3 ⇄	P=3+	
17. + 135-142					P_3		R,T,C For
	ACC = + ⇄				H_1 ⇄	H=1	
					R_4		
					P_3		
					T_2		
					R_3		
	ACC = - ⇄				T_3 ⇄	Too far	
					C_2 ⇄	C=2-	
	ACC = + ⇄				T		
18. + 143-144	ACC = + ⇄				P_3 ⇄	P=3+	
					P_1 ⇄	P=1-	
	ACC = ? ←				P_{toe} ⇄	P=toe	

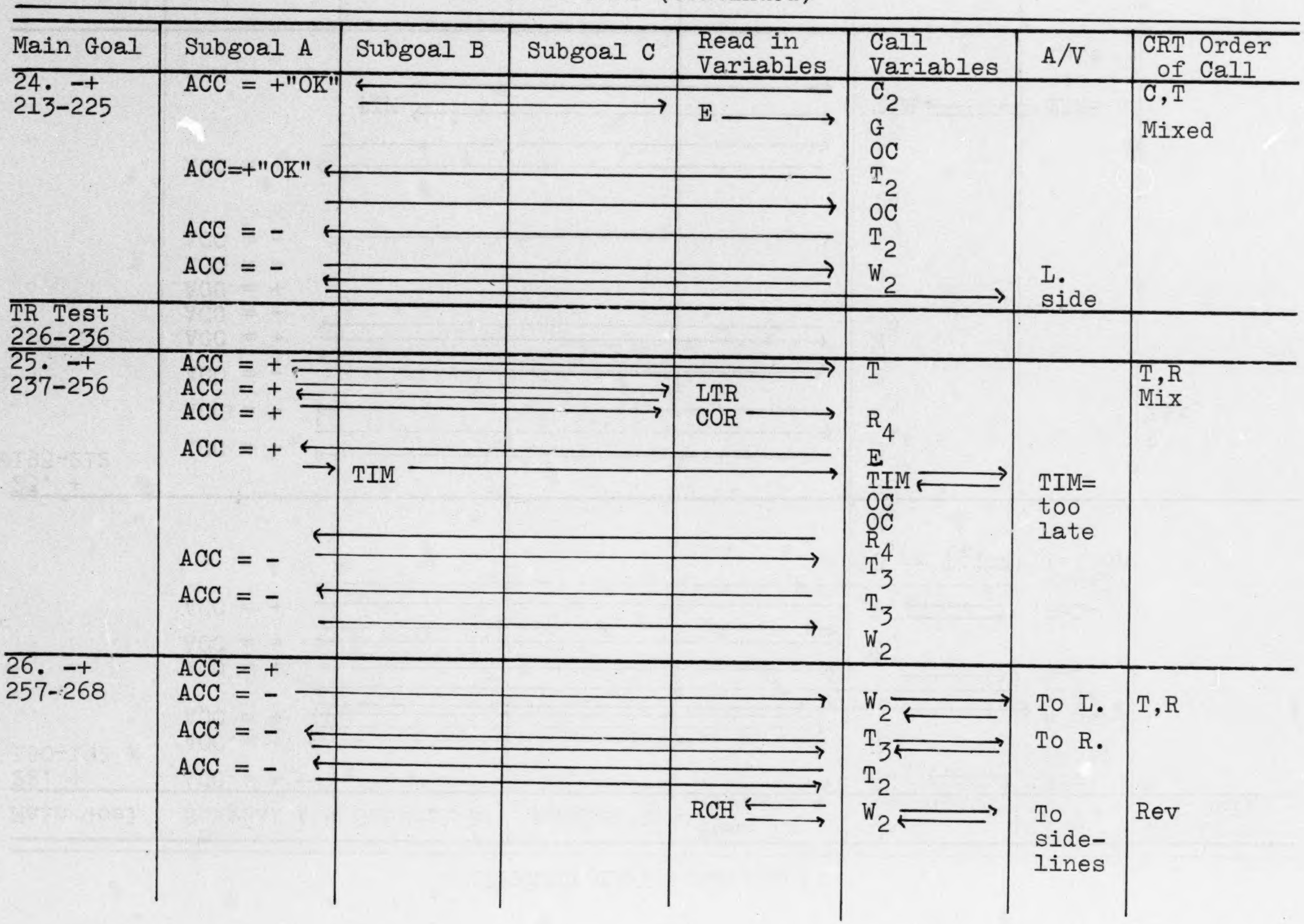
APPENDIX XXII (continued)

Main Goal	Subgoal A	Subgoal B	Subgoal C	Read in Variables	Call Variables	A/V	CRT Order of Call
19. +	ACC = - ←			←	C_2		
Test	ACC = - ⇄			⇄	T_3		
145-158	→			→	F		C,T,R For
	ACC = + ←			←	P_3		
	ACC = + ⇄			⇄	T_3		
	→			→ OC ←	W		
				→	T_3		
					WB		
					B_1		
					T_2		
					R_4		
					P_3		
20. –+	ACC = + ←			←	T_2		T,R,C
159-174	→			→	P_1		
					T_3		
					R_4 ⇄	R= Curve	Only 1 Var. called
	ACC = + ←			←	T_3		
	→			→	T_2		
				RS_1 ← →	C_4 →	RS=1 too much	
21. +	ACC = - ←			←	T_3		
175-179	→			→	P_1 ⇄	P=1-	T,R Rev
					R_4		
					RS_2 ⇄	RS=not high enough	

APPENDIX XXII (continued)

Main Goal	Subgoal A	Subgoal B	Subgoal C	Read in Variables	Call Variables	A/V	CRT Order of Call
22. + 180-192	ACC = +				RS_3 ⇄	RS= higher	T
	ACC = +?				W_2		
	ACC = +					R hand side	
	ACC = +				G ⇄	G=-	
	ACC = +				W_2		
	ACC = +				P_1 ⇄	P=1- lucky	
					T_1 or T_3 ⇄	T=1 or 3	
					W_2		
23. + 193-212					RS_3		
	ACC = -				S_{14}		
	ACC = -				W_2		T Mix
	ACC = -				T_2		
	ACC = +				W_h		
	ACC = -						
	ACC = +						
	ACC = -						
	ACC = -				T_3		
					T_3		
	ACC = +				G		
					T_3		
		TIM			TIM ⇄	TIM= too late	
					W_2		

APPENDIX XXII (continued)



Main Goal	Subgoal A	Subgoal B	Subgoal C	Read in Variables	Call Variables	A/V	CRT Order of Call
24. −+ 213-225	ACC = +"OK" ←	←	←	←	C_2		C,T
		→	→	E →	G		Mixed
					OC		
	ACC=+"OK" ←	←	←	←	T_2		
	→	→	→	→	OC		
	ACC = − ←	←	←	←	T_2		
	ACC = − ⇄	⇄	⇄	⇄ →	W_2 →	L. side	
TR Test 226-236							
25. −+ 237-256	ACC = + ⇄	⇄	⇄	⇄	T		T,R Mix
	ACC = + ⇄	⇄	⇄	LTR			
	ACC = + →	→	→	COR →	R_4		
	ACC = + ←	←	←	←	E		
	→	TIM →	→	→	TIM ⇄	TIM= too late	
					OC		
					OC		
	←	←	←	←	R_4		
	ACC = − →	→	→	→	T_3		
	ACC = − ←	←	←	←	T_3		
	→	→	→	→	W_2		
26. −+ 257-268	ACC = +						
	ACC = − →	→	→	→	W_2 ⇄	To L.	T,R
	ACC = − ⇄	⇄	⇄	⇄	T_3 ⇄	To R.	
	ACC = − ⇄	⇄	⇄	⇄	T_2		
				RCH ⇄	W_2 ⇄	To side-lines	Rev

APPENDIX XXII (continued)

Main Goal	Subgoal A	Subgoal B	Subgoal C	Read in Variables	Call Variables	A/V	CRT Order of Call
					W_2		
	↓SPD ←	←	←	←	R_4		
	→	→	→	→	SPD ⇄	SPD=	
	ACC = − ←	←	←	←	T_2		
	→	→	→	→	E		
					T		
	ACC = −				G ⇄	vib- rating out	
					T_3 ⇄		
	←	←	←	←	T_2		
	ACC = − →	→	→	→	T(goal)		
27. + 269-285	ACC = +						
	ACC = − →	→	→	→	T_2 ⇄	To R.	T,C,R
	ACC = − ←	←	←	←			
	→	→	→	→	COR →		
	↑ACC = + ←	←	←	←	←	To R.	
	ACC = − →	→	→	→	W_2 ←	To L.	
					G ⇄	Turn- ing	Mix
					C_4		
					RCH		
					T_2		
					E ⇄	too low	
	ACC = + ←	← THINK ←	←	←	R_4		
	→	→ "Forgot how to do it"	→	→	T_2 ⇄	T=eye level+	

APPENDIX XXII (continued)

Main Goal	Subgoal A	Subgoal B	Subgoal C	Read in Variables	Call Variables	A/V	CRT Order of Call
28. + 286-292					P_3		R,T For
					P_1		
	ACC = + ←				R_4 ⇄	To R.	
	ACC = − →				R_4 ⇄	To L.	
				←	T_2		
				TOP →	W_2		
29. ? 293-302	ACC = + ←				T_2		T
	ACC = + →				W_2		
	ACC = + ←						For
	ACC = + →				W_2 ⇄	More or less	
	ACC = − ←				P_1		
	↓SPD ← →				SPD		
	ACC (Goal) → to R				P_1 or ⇄	P=1? to R	
					P_3(goal) ⇄	P=3?	
30. ? 303-326	ACC = − ←				W		
	→				WB ⇄	Too far	C,T,R
					P_3 ⇄	Re-ject	Mix
					C_2 ⇄	−	
	ACC = − ←				COR		
	ACC = − ← →				W_2		
	ACC = + →				T ⇄	T=eye level	
					E ⇄	E=side arm	

APPENDIX XXII (continued)

Main Goal	Subgoal A	Subgoal B	Subgoal C	Read in Variables	Call Variables	A/V	CRT Order of Call
					W_2		
					COR		
					T_1		
					W_2		
	ACC = + ←	←	E + W ←	←	E		
Rest ←	→	→	→	→	R_4		
				HR ⇄	⇄	come up with head of racket	
←	→	→	→	→	E		
					R_4		
			E+T = -ACC ←	←	W_2		
	ACC = - ←	←					
	→	→	→	→	E		
					R_4		
					W_2		
31. - 327-360	ACC = + →	→	→	→	W_2		C,R,T
	ACC = - ←	←	←	←			
	ACC = - →	→	→	→	C_4		Mix
					C_4		
	ACC = - ←	←	←	←	W_2		
	ACC = - →	→	→	→	R_4		
	←	←	←	←			
	→	→	→	→	W_2 ⇄	⇄	To R.
	SPD = - ←	←	←	←	OC		
	ACC = + →	→	→	→	P_1		
	ACC = - ←	←	←	←			
	ACC = - ⇄	⇄	⇄	ARCH			

APPENDIX XXII (continued)

Main Goal	Subgoal A	Subgoal B	Subgoal C	Read in Variables	Call Variables	A/V	CRT Order of Call
	SPD = − →	→	→	→	SPD →	Too hard R. hand corner	
	ACC = + ←	←	←	←	←		
	ACC = − →	→	→	→	→	To L.	
	ACC = ←	←	←	←	W_2 ←	To R.	
	− to R. →	→	→	→			
	ACC = + ←	←	←	←	C ⇄	C=?	
	SPD = − →	→	→	→	OC ⇄	too hard	
	ACC = − ←	←	←	←	T_2		
TR Test 361-371							Exp.
TR 371-373							Exp.
32. + 374-402	ACC = + ⇄	⇄	⇄	⇄	T_1		T,R
	ACC = + ⇄	⇄	⇄	⇄	E_2		
	ACC = − ←	←	←	←			Mix
	ACC = − →	→	→	→	COR		
	ACC = + ←	←	←	←			
	ACC = − →	→	→	→	W_2 ⇄	too deep	
	ACC = ←	←	←	←			
	+ to R →	→	→	→	R_4 →	to R.	
	to L ←	←	←	←	←	to L.	
	ACC = −						
	ACC = −						
	ACC = →	→	→	→	W_2 ⇄	to R.	
	− to R ←	←	←	←			
	to L →	→	→	→	R_4 → ←	to L.	

APPENDIX XXII (continued)

Main Goal	Subgoal A	Subgoal B	Subgoal C	Read in Variables	Call Variables	A/V	CRT Order of Call
	ACC = + ←				W_h		
	→			→	E_2		
	ACC = + ←				W_2		
	ACC = - ← →			→	G ⇄	G=?	
33. ? 403-438	ACC ←	FEEL ←			E ⇄	E=2-	R,T
					E ⇄	E=1+	Rev
	→			→	E_2		
	ACC = - ←				S_{13}		
	ACC = - →			→	R_4 ⇄	To L.	
	ACC = + ← →			→	E_2		
	ACC = - ←						
	ACC = +						
	ACC = -						
	ACC = -						
	ACC = -						
	ACC = + →			→	T_2		
	ACC = +? ← →			→	W_2		
	ACC = - ←				T_2		
	→			→	E_2		
34. ? Test 439-449	ACC = - →			→	W_2 ⇄	-	
				WIND ←			
35. -+ 450-460	ACC = - ←				E_2 ⇄	To L.	Exp.
	→			→	E_1		Rev.
	ACC = - to R. ←				W_2 ⇄	To R.	
	→			→	E_2		

APPENDIX XXII (continued)

Main Goal	Subgoal A	Subgoal B	Subgoal C	Read in Variables	Call Variables	A/V	CRT Order of Call
					E_2		
					P_3 ⇄	P=3-	
					P_1(goal) ⇄	P=1+	
36. ? 461-483	ACC = − →	→	→	→	E_2		T
	ACC = + ←	←	←	←	W_2		
	ACC = − →	→	→	→	W_2		Rev
	ACC = − ←	←	←	←			
	ACC = +						
	ACC = −						
	ACC = − ⇄	⇄	⇄	⇄	E_1		
	ACC = +						
	→	COOR →	→	→	W_2 ⇄	"working better now"	
			E + T = W ←	←	E_1		
				→	T_1		
		CON ⇄	⇄	⇄	W_2		
			T_2+W_2=ACC- into net ←	←	T_2		
				→	W_2 ⇄	into	
			T_3 = ACC - too far ⇄	⇄	T_3 →	net too far	
37. + 484-517	ACC = + →	→	→	→	E_1		T
	ACC = − ←	←	←	←			
	ACC = −						For
	ACC = −						
	ACC = + →	→	→	→	E_1		

APPENDIX XXII (continued)

Main Goal	Subgoal A	Subgoal B	Subgoal C	Read in Variables	Call Variables	A/V	CRT Order of Call
	ACC = −				T_2	to L.	
	ACC = −				T_1		
	ACC = +						
	ACC = −					to L.	
	ACC = −				COR	to L.	
	ACC = −					Out	
	ACC = −					to L.	
	ACC = −					to R.	
	ACC = −					to R.	
	ACC = −					to R.	
	ACC = −				RCH	to R.	
	ACC = +					Right hand cor.	
38. ? 518-579	ACC = +				G_1 (goal)	G=1+	R,C
					R_4	to R.	Mix
					W_2		
					C_4		
	ACC = −				E_2	to R.	
	ACC = − ACC = +				P_1	to L.	
	ACC = −				G_1	G=1− to R.	
	ACC = −	FEEL			COOR		
		COOR				−	
	ACC = −						
	ACC = −					too far	
	ACC = +						
	ACC = +						

APPENDIX XXII (continued)

Main Goal	Subgoal A	Subgoal B	Subgoal C	Read in Variables	Call Variables	A/V	CRT Order of Call
	ACC = -				W_2	to R.	
	ACC = +				G_1	wobbly	
					COOR		
					G	tighter	
39.? 580-595	ACC = -				R_4	out	T,C,R
	ACC = -					to L.	Mix
	ACC = -					to R.	
	ACC = -					to R.	
					G_1		
	SPD = -				T_1		
					ARCH		
			$RS+W_2+C$		C_1	C=1+	
					RS		
			$RS+W_2+C$ $+B$		W_2		
					B		
40. ? 596-640	ACC = -					out	C
	ACC = -					long	Mix
	ACC = -					to R.	
	ACC = -					to L.	
	ACC = +				E_2	R.hand cor.	
					W_2		
	ACC = -				COOR	to L.	
	ACC = -				W_2	to R.	
					W_2		
	ACC = -				C_4	to L.	
	ACC = ?				W		
	ACC = +				E_2		
	SPD = -			WIND=SPD↑	WIND		

APPENDIX XXII (continued)

Main Goal	Subgoal A	Subgoal B	Subgoal C	Read in Variables	Call Variables	A/V	CRT Order of Call
	ACC = +-	→	→	↓WIND=SPD↑			
	ACC = -	← →	← →	← →	← →	to R.	
	ACC = -	← →	← →	← →	← →	to R.	
	ACC = -	→	→	→	→	to L.	
	ACC = -					"Left-hand thing" disgust	

APPENDIX XXIII

Subject 2: SYNOPSIS OF VERBAL-MOTOR BEHAVIOR GRAPH

- - +		?		+ + -	
CRT	Order of Call	CRT	Order of Call	CRT	Order of Call
7. T	Mix	13. C,R,T	Rev	1. T,R	Exp.
8. -	Rev	16. T,R,C	Mix	2. C	Exp.
9. T	For	29. T	For	3. T	Exp.
12. R,T	Rev	30. C,T,R	Mix	4. T	Exp.
15. T,R	Mix	33. R,T	Rev	5. -	Rev.
18. -	-	36. T	Rev	6. T	For
19. C,T,R	For	38. R,C	Mix	10. T	Mix
24. C,T	Mix	39. T,C,R	Mix	11. R,T	Rev
25. T,R	For	40. C	Mix	14. T,R	For
26. T,R	Rev			17. R,T,C	For
31. C,R,T	Mix			20, T,C,R	Only 1 var.
31. -	Rev			21. T,R	Rev
				22. T	Rev
				23. T	Mix
				27. T,C,R	Mix
				28. R,T	For
				29. T,R	Mix
				37. T	For
TOTALS T = 2 RT = 1 TR = 3 CT = 1 CTR= 1 CRT= 1	Mix = 5 Rev = 4 For = 3	C = 1 T = 2 RC = 1 RT = 1 TCR = 1 CTR = 1 TRC = 1 CRT = 1	Mix = 5 Rev = 3 For = 1	C = 1 T = 7 TR = 4 RT = 2 RTC = 1 TRC = 1 TCR = 1	Mix = 4 Rev = 4 For = 6

APPENDIX XXIV

Subject 2: ANALYSIS OF VERBAL PROBLEMS BY MOTOR PLOT SCORES

Problem	Episodes	#Episodes	Sol. Code[a]	Range of Scores	Motor Plot Total Score	Initial Score	Final Score	Mean Score
1	1-3	3	3	17-19	55	17	19	18.33
2	4-8	5	3	9-22	88	18	22	17.60
3	9-13	5	3	16-24	100	24	22	20.00
4	14-17	4	3	20-26	89	20	20	22.25
5	18-19	2	3	18-18	36	18	18	18.00
6	20-23	4	3	12-25	73	12	17	18.25
7	24-33	10	2	8-29	162	19	21	16.20
8	34-41	8	2	13-27	133	14	15	16.63
9	42-67	26	2,7	9-29	434	15	18	16.69
10	68-75	8	5	13-26	149	13	15	18.63
11	76-85	10	3	15-18	165	17	15	16.50
12	86-90	5	4	16-18	86	16	18	17.20
13	91-99	9	1	15-24	172	17	21	19.11
14	100-106	7	3	14-33	138	15	18	19.71
15	107-126	20	2	11-24	344	15	21	17.20
16	127-134	8	1	14-29	153	20	17	19.13
17	135-142	8	3	14-23	153	16	18	19.13
18	143-144	2	3	18-24	42	24	18	21.00
19	145-158	14	3,7	14-30	310	21	18	22.14
20	159-174	16	4	21-33	411	24	24	25.69
21	175-179	5	3	24-26	123	24	26	24.60
22	180-192	13	3	20-30	313	29	26	24.08
23	193-212	20	3	24-35	570	34	27	28.50
24	213-225	13	4	21-40	366	27	27	28.15
TR	226-236	11	6,7	24-41	342	26	29	31.09
25	237-256	20	4	18-38	532	31	24	26.60

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[a] See Appendix VI for key to solution codes for problems.

APPENDIX XXIV (continued)

Problem	Episodes	#Episodes	Sol. Code[a]	Range of Scores	Motor Plot Total Score	Initial Score	Final Score	Mean Score
26	257-268	12	4	24-31	316	24	27	26.33
27	269-285	17	3	24-32	431	27	24	25.35
28	286-292	7	3	24-32	196	30	24	28.00
29	293-302	10	1	20-30	245	24	29	24.50
30	303-326	25	3	24-41	752	29	34	30.08
31	327-360	34	2	19-35	976	27	30	28.70
TR	361-370	10	7	30-42	346	35	36	34.60
TR	371-373	3	6	30-34	98	34	30	32.67
32	374-402	29	3	28-44	1002	36	35	34.55
33	403-438	36	1	23-44	1217	32	33	33.81
34	439-449	11	1,7	27-34	350	32	33	31.82
35	450-460	11	4	22-42	376	22	34	34.18
36	461-483	23	1	21-50	826	36	36	35.91
37	484-517	34	3	25-49	1132	34	34	33.29
38	518-579	62	1	20-36	1781	36	27	28.72
39	580-595	16	1,7	26-39	519	31	35	32.44
40	596-639	44	1,7	25-52	1575	43	34	35.80

APPENDIX XXV

Subject 2: ANALYSIS OF HIGHEST SCORES DURING EACH PROBLEM

Problem	Episode	Score	Analysis of Verbal Data Around Highest Score	Result
1	2,3	19	Goal=toss higher, racket low enough, ↑ force; combining	+A/V
2	7,8	22	Goals: ACC, C, T	–
3	9	24	T=too low, goal=toss higher	–
4	15	26	"Racket kind of turned in my hand"	–
5	–	18		
6	22	25	"I leaned to the L. and racket turned to the R"; combining 2 props.	–
7	32	29	"I didn't do as well when I stand at my side"	–
8	38	27	NC; goal (37) = C	+
9	53	29	NC; goal (52) = T	+
10	70	26	Goal: ACC	+
11	80	18	Goal: ACC	+
12	88-90	18	HD + Straight racket; combining props.	
13	93	24	Goal: ACC+SPD; combining props.	+
14	104	33	Goal: ACC+TIM+dropping it down	+
15	125	24	Goal: ACC "Too far to the R"	–
16	133	29	Goal: ACC "Too far out"	–
17	141	23	Goal: C "That one was completely over my head"	–
18	143	24	Goal: Body position "turned too much to the R-hand side"	–
19	148	30	Goal: Body position "That one was pretty good because I didn't turn my body"	+
20	162,170	33	Goals: C and T; NC; combining	–
21	179	26	Goal: swing higher; A/V	+
22	181	30	Goal: C	+
23	197	35	Goal: ACC, "Too far I think"	–
24	224	40	"I'm slapping the ball down again"	–
TR	235	41	"OK"	
25	251	38	NC; 250=C + P + CON, G tight + dropping down + TIM + OC; combining of previous props. into larger subgoals	+
26	262	31	Goal: T=3; T + HD, combining props.	–
27	281	32	"Racket too low, turning it to the L"	–

APPENDIX XXV (continued)

Problem	Episode	Score	Analysis of Verbal Data Around Highest Score	Result
28	289	32	Goal: ACC + P; combining of properties	-
29	294	30	Goal: ACC + C + HD + TOP; combining	+
30	310	41	Goal: CON + T + P + Slapped Down; combining of props.	
31	328-330	35	Goal: ACC; Slapping + C = ACC; A/E, Combining	+
TR	363	42	NC; testing	TR
TR	371-372	34	NC	TR
32	385	44	"That one I've got to turn it more to the R."	+
33	422	44	Goal: ACC + C; combining, narrowing of goal into larger elements	
34	448	34	NC	Testing
35	457	42	Goal: ACC; T + C = ACC, combining A/E	
36	462	50	ACC = T; A/E	Testing 1 prop
37	499	49	Goal: ACC	-
38	518	36	NC; Goal: G + ACC; 1 property	
39	582	39	Goal: ACC, G	-
40	597	52	NC	TR, Testing

APPENDIX XXVI

Subject 2: INCREASES AND DECREASES IN MOTOR PERFORMANCE SCORES WITHIN AND BETWEEN DAYS

Days	Increases	Decreases	Scores Remaining the Same	Total
Between	3 (50.00%)	3 (50.00%)	0 (00.00%)	6
Within	14 (38.88%)	15 (41.66%)	7 (19.44%)	36
Total	17 (40.47%)	18 (42.85%)	7 (16.66%)	42

APPENDIX XXVII

Subject 2: THE EFFECTS OF REST UPON THE WITHIN DAY INCREASES AND DECREASES OF MOTOR PERFORMANCE SCORES

Increases with Rest	Increases Without Rest	Decreases With Rest	Decreases Without Rest	Stays Same With Rest	Stays Same Without Rest	Total
2 (5.55%)	12 (33.33%)	5 (13.88%)	10 (27.77%)	2 (5.55%)	5 (13.88%)	
Total	14 (38.88%)		15 (41.66%)		7 (19.44%)	36

APPENDIX XXVIII

Subject 2: ANALYSIS OF VERBAL PROBLEMS BY ACCURACY/SPEED SCORES

Problem	#Episodes	Raw Score Accuracy	Raw Score Speed	Accuracy Ratio (6 max)	Speed Ratio (4 max)	Sol. Code[a]
1	3	1	1	.33	.33	3
2	5	11	6	2.20	1.20	3
3	5	10	4	2.00	.80	3
4	4	2	2	.50	.50	3
5	2	1	1	.50	.50	3
6	4	2	2	.50	.50	3
7	10	8	8	.80	.80	2
8	8	6	6	.75	.75	2
9	26	17	12	.65	.46	2,7
10	8	3	3	.38	.38	5
11	10	10	9	1.00	.90	3
12	5	4	4	.80	.80	4
13	9	9	6	1.00	.67	1
14	7	2	2	.29	.29	3
15	20	21	10	1.05	.50	2
16	8	5	3	.63	.38	1
17	8	8	4	1.00	.50	3
18	2	1	1	.50	.50	3
19	14	12	9	.86	.64	3,7
20	16	15	12	.94	.75	4
21	5	4	3	.80	.60	3
22	13	24	11	1.85	.85	3
23	20	15	11	.75	.55	3
24	13	10	7	.77	.54	4
TR	11	18	10	1.64	.91	6,7
25	20	10	9	.50	.45	4
26	12	7	6	.59	.50	4
27	17	13	11	.76	.65	3
28	7	2	2	.29	.29	3
29	10	9	5	.90	.50	1
30	25	13	11	.52	.44	3
31	34	23	16	.68	.48	2
TR	10	19	8	1.90	.80	7
TR	3	1	1	.33	.33	6
32	29	25	16	.86	.55	3
33	36	35	21	.97	.58	1
34	11	6	5	.55	.46	1,7
35	11	10	8	.91	.73	4
36	23	25	16	1.09	.70	1

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[a] See Appendix VI for the key to the symbols given.

APPENDIX XXVIII (continued)

Problem	#Episodes	Raw Score Accuracy	Raw Score Speed	Accuracy Ratio (6 max)	Speed Ratio (4 max)	Sol.Code
37	34	31	24	.91	.71	3
38	62	34	26	.55	.42	1
39	16	11	6	.69	.38	1,7
40	44	32	19	.73	.43	1,7

APPENDIX XXIX

Subject 2: INCREASES AND DECREASES IN ACCURACY AND SPEED SCORES WITHIN AND BETWEEN DAYS

ACCURACY

Days	Increases	Decreases	Scores Remaining the Same	Total
Between	1 (16.66%)	4 (66.66%)	1 (16.66%)	6
Within	9 (25.00%)	10 (27.77%)	17 (47.22%)	36
Total	10 (23.80%)	14 (33.33%)	18 (42.85%)	42

SPEED

Days	Increases	Decreases	Scores Remaining the Same	Total
Between	1 (16.66%)	4 (66.66%)	1 (16.66%)	6
Within	7 (19.44%)	12 (33.33%)	17 (47.22%)	36
Total	8 (19.04%)	16 (38.09%)	18 (42.85%)	42

APPENDIX XXX

Subject 2: THE EFFECTS OF REST UPON THE WITHIN-DAY INCREASES AND DECREASES OF ACCURACY AND SPEED SCORES

ACCURACY

Increases with Rest	Increases Without Rest	Decreases With Rest	Decreases Without Rest	Stays Same With Rest	Stays Same Without Rest	Total
5 (13.88%)	4 (11.11%)	3 (8.33%)	7 (19.44%)	2 (5.55%)	15 (41.66%)	36
Total	9 (25.00%)		10 (27.77%)		17 (47.22%)	36

SPEED

Increases with Rest	Increases Without Rest	Decreases With Rest	Decreases Without Rest	Stays Same With Rest	Stays Same Without Rest	Total
3 (8.33%)	4 (11.11%)	3 (8.33%)	9 (25.00%)	4 (11.11%)	13 (36.11%)	36
Total	7 (19.44%)		12 (33.33%)		17 (47.22%)	36

APPENDIX XXXI

Subject 3: HEWITT SERVE TEST SCORE ANALYSIS

Day	EPS	Raw Accuracy Score	Raw Speed Score	T-Score Accuracy	T-Score Speed
1	44-53	7	4	60	53
2	116-125	6	6	58	60
3	233-242	13	6	70	60
4	354-363	6	7	58	63
5	432-441	6	3	58	51
6	536-545	8	6	63	60
7	580-590 (1 let)	2	3	48	51

APPENDIX XXXII

Subject 3: ACCURACY-SPEED MEAN DAILY SCORES

Day	#of Serves	Raw Accuracy Scores	Raw Speed Scores	Mean Accuracy	Mean Speed
1	53	42	31	.79	.58
2	72	38	35	.52	.48
3	109	111	60	1.01	.55
4	114	95	73	.83	.64
5	78	45	24	.57	.30
6	104	69	53	.66	.50
7	45	24	21	.53	.46
Total	575	389	297	4.91	3.51

Average mean accuracy = .67
Average mean speed = .51

APPENDIX XXXIII

ORDER SUBJECT 3 READS IN VARIABLES, PROPERTIES AND ELEMENTS

1. FEEL = feel comfortable, +
2. ACC
3. G = grip
4. T = toss
5. E = arm straight, arm curved; A/V, test?
6. EYES = eyes on the ball
7. F = follow through
8. P = starting position
   (T = T_1 toss correct height, A/V +)
9. C = toss in front of the body, C = C_1; A/V +
   (T = T_2, toss lower; A/V, +)
10. RCM = continuous motion, roundness type thing
11. TIM = slowing down, A/V, -
12. SPD = too hard, A/V, +
13. R = batting the ball, A/V, -
   (R = hitting the ball down, A/V, +)
   (R = pushing the ball into the ground, A/V, -)
   (R = putting the ball into the air, A/V, +)
   (P = out of position, A/V, -)
14. TOP = tops the ball
15. S = feet
16. WB = whole body, +
   (T = T_3 A/V, -)
17. W = wrist
18. CON = concentrate
19. ARCH = bend backward, +
   (Foul = net)
20. S_{14} = bent knees, +
   (P_3 = facing net, A/V, -)
   (T_1 = re-accepts)
21. RW = racket heavier, +
22. OC = off center, -
23. LEAN = +
   (P_1 = point feet in direction want ball to go, A/V, +)
24. PRACTICE = +
   (RCM = pendular motion, A/V, +)
25. CON = control, uncontrolled, A/V, +-)
   (R = batting ball, +)
   (R = pounding into the ground, -)
   (W_4 = wrist whipped, not hyperextended, A/V)
26. RS = swing, total swing
   (C_4 = toss too far in front, A/V, -)
   (TIM = too late, A/V, -)

APPENDIX XXXIII (continued)

(C_3 = toss out to the side, A/V, -)
(C_1 = re-rejects more positively)
(TIM = too soon, A/V, -)
27. SLB = swing like a baseball, A/V, -)
28. ARM = moving arm across, A/V)
(C_5 = toss right overhead, A/V, +)
29. RCH = reach
(RW = racket lighter, A/V)

APPENDIX XXXIV

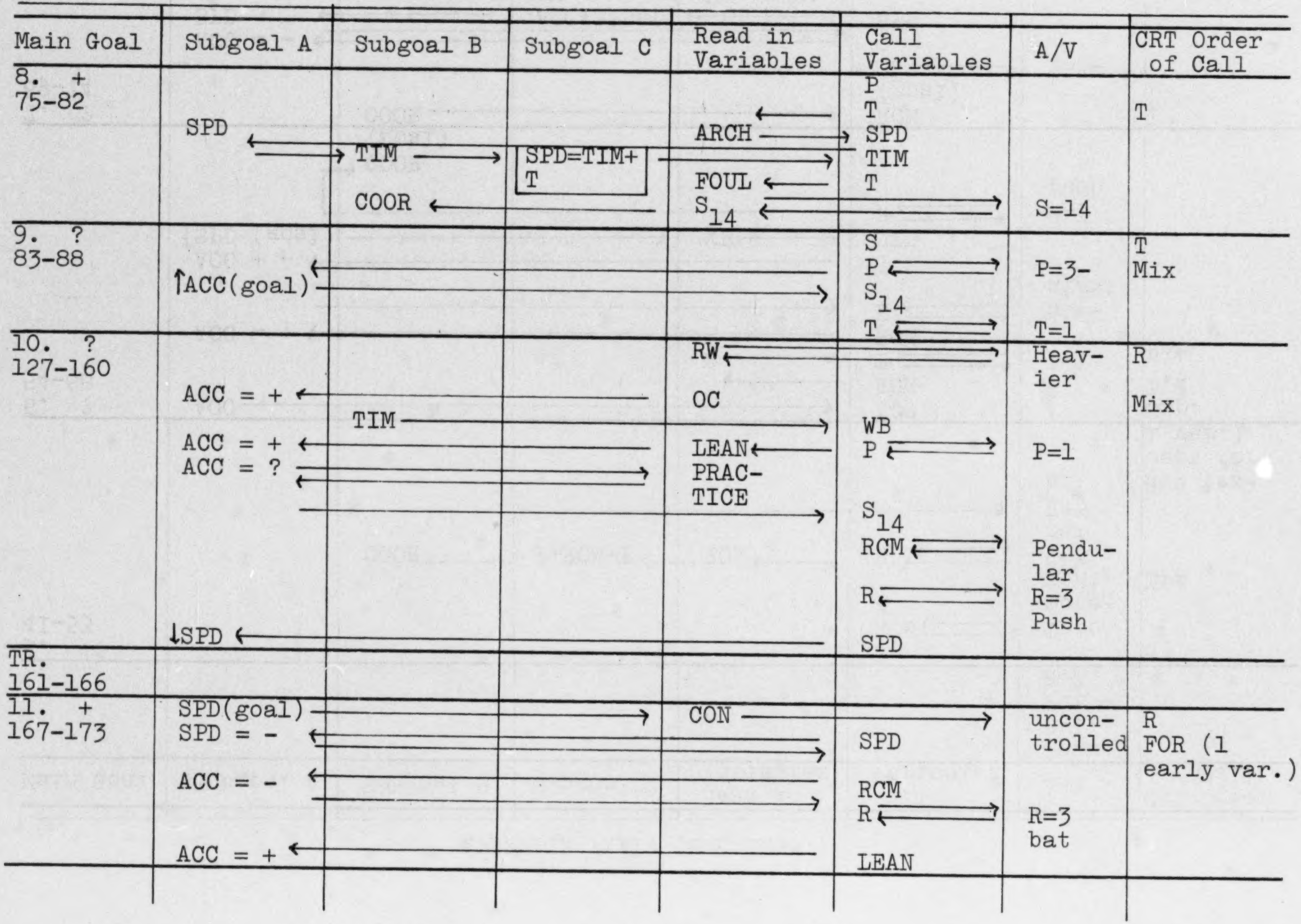
Subject 3: VERBAL-MOTOR BEHAVIOR GRAPH

Main Goal	Subgoal A	Subgoal B	Subgoal C	Read in Variables	Call Variables	A/V	CRT Order of Call
1. ? 1-12	ACC →	FEEL →	→	FEEL →	→	comfortable?	Exp.
				ACC G T E →	→	E=curved or straight	T
				EYES ←	←		
		FEEL ←	←	F			
2. ? 13-22		FEEL →	→	P ⇄	⇄	Awkward	Exp. T,C
					T ⇄	T_1 or 3?	
				C ←	←	C=1	
3. ? 23-28	ACC ←	←	←	←	ACC		T
	→	→	→	T ⇄	⇄	T=2+	For
4. ? 29-40		RCM →	→	RCM ⇄	⇄	continuous,	Exp.
				F ←	←	Roundness	R
		←	←	RCM			
	↓SPD ←	TIMING		TIMING	⇄	Slowing down	
	SPD →	→	→	SPD →			
		FEEL ←	←	R ←	RCM ⇄	Bat- R=3 Hit+ R=3	

APPENDIX XXXIV (continued)

Main Goal	Subgoal A	Subgoal B	Subgoal C	Read in Variables	Call Variables	A/V	CRT Order of Call
						Push- R=1 Put + R=2	
5. +? 41-53					P RCM ⇄ F	Type move- ment	R
		COOR ←	P+RCM+F ←	TOP ←	R ⇄	R=3 bat	Mix
		→	→	→	→	R=3 hit	Rev (ex- cept for 1 var.)
6. ? 54-68	ACC →	→	→	→	ACC		Exp. T,R
				←	RCM		
				S →	T ⇄	T=1	For
	ACC = + ←	←	←	←	RCM		
	→	→	→	→	E ⇄	str- aight	
	ACC + - ←	←	←	←	G		
	↑SPD (goal) →	→	→	WB →	SPD		
					R ⇄	R=3 push	
	→	COOR (goal)					
7. ? 69-74		COOR →	→	→	RCM (goal)		T
					T ⇄	T=3-	
	ACC = - ←	←	←	← →	T		
	SPD ←	←	ACC+SPD=T ←	←	SPD		
		→	+W →	W CON			

APPENDIX XXXIV (continued)



Main Goal	Subgoal A	Subgoal B	Subgoal C	Read in Variables	Call Variables	A/V	CRT Order of Call
8. + 75-82	SPD	TIM COOR	SPD=TIM+ T	ARCH FOUL S_{14}	P T SPD TIM T	S=14	T
9. ? 83-88	↑ACC(goal)				S P S_{14} T	P=3- T=1	T Mix
10. ? 127-160	ACC = + ACC = + ACC = ? ↓SPD	TIM		RW OC LEAN PRACTICE	WB P S_{14} RCM R SPD	Heavier P=1 Pendular R=3 Push	R Mix
TR. 161-166							
11. + 167-173	SPD(goal) SPD = - ACC = - ACC = +			CON	SPD RCM R LEAN	uncontrolled R=3 bat	R FOR (1 early var.)

APPENDIX XXXIV (continued)

Main Goal	Subgoal A	Subgoal B	Subgoal C	Read in Variables	Call Variables	A/V	CRT Order of Call
12. ? 174-187	ACC = + ←				RCM		R,T
				→	R ⇄	R=3	For
					T ⇄	T=2	
	SPD ←				R ⇄	R=3	
				→		pound-ing	
			ACC = T_2 ← A/E		T ⇄	T=2+	
13. ? 188-212	ACC = - ←				T ⇄	T=2	T,R
					T ⇄	T=3	For
				→	RCM		
					R ⇄	R=1	
						Push	
					T ⇄	T=3	
					T ⇄	T=2	
	ACC = + ←				RCM,R ⇄	R=1	
						Push	
				→	T ⇄	T=3	
	ACC = - ←			→	T ⇄	T=2	
	↓SPD(goal)		$\underset{?}{T_2}+T_3$=+ ←		OC ⇄	OC=-	
14. ? 213-236	ACC →		T_3 or T_2 or T_1 ?	→	T ⇄	T=3	
					T ⇄	T=2	T,R
					T ⇄	T=1	Mix
		COOR ⇄	ACC=T_3 or T_2 or T_1 ?	⇄	W		
					T ⇄	T=3	
	ACC = - ←				W ⇄	W=4?	
				→	RCM,R		
	ACC = - ←				T ⇄	T=3	
				→	T ⇄	T=2	
	ACC = -			→	OC		
			T_2+RCM+R ←		RCM,R		

APPENDIX XXXIV (continued)

Main Goal	Subgoal A	Subgoal B	Subgoal C	Read in Variables	Call Variables	A/V	CRT Order of Call
15. ? 237-242	↓SPD		T_2 or T_3 or T_1?	→	T ⇄	T=2	T
	←	←	←	←	T ⇄	T=3	1 early var.
	→	→	T_2 or T_3 or T_1 ?	→	T ⇄ P	T=1	
16. - 250-270			T_2 or T_3 or T_1 ?	→	P		T
		COOR ←		←	CON		Mix
		→	→	→	T ⇄	T=2	
					T ⇄	T=3	
			T_2=CON	⇄	CON		
					T ⇄	T=2	
		COOR ⇄	T_2=CON ⇄	⇄	T ⇄	T=3	
					T ⇄	T=2	
"just luck"					OC		
17. ? 271-288			Goal- Find T	→	T ⇄	T=3	
		TIM ←	←	←	TIM		T,R
	ACC = - ←	→	→	→	T ⇄	T=2	
	←	←	←	←	T ⇄	T=1 or 3	Rev
	↑SPD ←	←	←	←	CON		
	→	→	→	→	RS OC		
	SPD = - ←	←	←	←	T ⇄	T=2	
	→	→	→	→	T ⇄	T=2	
	ACC = - ←	←	←	←	RCM,R ⇄	R=3 hit	

APPENDIX XXXIV (continued)

Main Goal	Subgoal A	Subgoal B	Subgoal C	Read in Variables	Call Variables	A/V	CRT Order of Call
18. + 289-316		FEEL COOR ←	———	———	FEEL C ⇄ COOR	C+4-	C,T Rev (except for P)
		———	———	——→	T ⇄	T=3	
	ACC = - ←	———	———	———	P		
		———	———	——→	OC		
		CON TIM ←	———	———	CON TIM ⇄	too late	
		———	———	——→	C ⇄	C=3	
	ACC = + ←	FEEL ←	———	———	C ⇄	C+?	
	———	——→	C + T ——	——→	FEEL ⇄	comf=-	
	ACC = - ←	———	———	———	T ⇄	T=?	
	ACC = + →	FEEL↑Conf. (goal)			C ⇄	C=1+ Comf	
19. ? 317-348	ACC = + ← SPD = ?	———	———	———	C(goal) ⇄ ACC SPD	C=1?	C,T
	SPD = +	———	———	——→	C ⇄	C=1+	Rev (except for OC)
	←	———	———	———			
	SPD = + ⟷	CON ——	———	——→	CON		
	ACC = + ←	———	———	——→	C ⇄	C=4-	
		TIM ←	———	———	TIM ⇄	too soon	
		——→	TIM + T_2= too close to the body	——→	RCM,R ⇄	jerky	
		COOR FEEL ←	———	——→	OC ⇄	comf. dis- gust	
	ACC = - ←	———	———	———			

APPENDIX XXXIV (continued)

Main Goal	Subgoal A	Subgoal B	Subgoal C	Read in Variables	Call Variables	A/V	CRT Order of Call
20. ? 349-351	ACC = - →	→	T ? →	→	T ⇄	T=3	T
	←	←	←	←	T ⇄	T=2	
	ACC = + →	→	→	→	T ⇄	T=2	
	↑ACC(goal) ←	FEEL ←	←	←		comf.	
confused	→	(goal= ↑comf.	T=? 3, 2?				
21. Test TR 252-364							
22. + 365-384	ACC →	→	→	→	C ⇄	C=1	
					T ⇄	T=2	C,T Rev
	ACC = - ←	FEEL ← (goal= comf.)	←	SLB ←	←	Comf. swing like base- ball	
	ACC = + ←	→	Test T? ← $\boxed{C_1+T_2}$	←	P ⇄ T ⇄ C ⇄	P=- T=1 C=1	
23. ? 385-398	ACC = - ←	FEEL ← (comf.+)	→	→	T ⇄	Comf.+ T=1 or 3	T
	SPD = + ←	→	→	→	T ⇄ T ⇄	T=2 T=1	
confused	ACC = + →	FEEL (comb.?)				Comf.?	
24. ? 399-427	ACC(goal) →	→	→	→	S		
	←	←	P_2or P_3? ⇄	⇄	P ⇄ P ⇄	P=3 P=2	T,C
	ACC = - →	→	→	ARM ⇄	⇄	mov- ing across body	Rev

APPENDIX XXXIV (continued)

Main Goal	Subgoal A	Subgoal B	Subgoal C	Read in Variables	Call Variables	A/V	CRT Order of Call
	ACC(goal) ←				T		
	→			→	G		
					P		
				←	C ⇄	C=1	
			RCH + C_5?= ACC A/E	RCH →	C ⇄	C=5+	
TR Test 428-442							
25. ? 443-503	ACC(goal) →	TIM →		→	TIM		
	SPD(TEST) ←						T,R For
	ACC = +						
	SPD(TEST) ⇄				→	Too hard or too soft	
	SPD = + →	TIM →		→	TIM ⇄	too soon	
	ACC = − ←						
	ACC = − →	TIM →		→	TIM ⇄	too late	
	ACC = − ←	TIM ←	too hard	←			
	SPD(TEST) →		ortoo soft	→	T ⇄	T=3	
	ACC = − ←				T ⇄	T=2	
	ACC = − ←		↑SPD +↑ACC	←	RCM,R ⇄	R=3	
	→		How?	→			
	←	TIM ←			TIM ⇄	too late	
	ACC = +						
	→	TIM →		→	TIM ⇄	too soon	
			↑SPD +↑ACC? (goal)	←			

APPENDIX XXXIV (continued)

Main Goal	Subgoal A	Subgoal B	Subgoal C	Read in Variables	Call Variables	A/V	CRT Order of Call
26. + 504-545	SPD = + →	→	→	→	C ⇄	C=4	C,T
					RW ⇄	hea-vier	
					EYES		Mix
					T		
	ACC = - ←	←	←	←	RW ⇄	ligh-ter	
	→	→	→	→	OC		
					C ⇄	C=5	
					C ⇄	C=1	
					RCM ⇄	fuller	
					T ⇄	T=1	
					T ⇄	T=3	
					C ⇄	C=5	
		FEEL ⇄	C_5+T_1+RCM ⇄	⇄	⇄	Comf.+	
			+ RW ⇄	⇄	RW ⇄	lighter	
			lighter = Comf.				
27. ? 546-590	ACC = - →	→	TEST T →	→	T ⇄	T=3	T,C
					C ⇄	C=1	Rev
	ACC = + ←	←	ACC=T_1 = C_1 ←	←	EYES ⇄	Ok	
	→	→	+ EYES				
	ACC = + ← →	FEEL	ACC = T_1+ ⇄	⇄	⇄	better	
			C_5+ EYES			Comb.+	
	ACC(goal) ← →	→	TEST T				

APPENDIX XXXV

Subject 3: SYNOPSIS OF VERBAL-MOTOR BEHAVIOR GRAPH

−	− +	?		+	+ −
CRT	Order of Call	CRT	Order of Call	CRT	Order of Call
16. T	Mix, For	1. T	−	5. R	Rev
19. C,T	Rev	2. T,C	−	8. T	For
		3. T	−	11. R	For
		4. R	−	18. C,T	Rev
		6. T,R	For	22. C,T	Rev
		7. T	−	26. C,T	Mix
		9. T	Rev		
		10. R	Mix		
		12. R,T	For		
		13. T,R	For		
		14. T,R	Mix		
		15. T	For		
		17. T,R	Rev		
		20. T	−		
		23. T	−		
		24. T,C	Rev		
		25. T,R	For		
		27. T,C	Rev		
TOTALS					
T = 1 CT = 1	Mix = 1 Rev = 0 For = 1	R = 2 T = 7 TC = 3 TR = 5 RT = 1	Mix = 2 Rev = 4 For = 4	R = 2 T = 1 CT = 3	Mix = 1 Rev = 3 For = 2

APPENDIX XXXVI

Subject 3: ANALYSIS OF VERBAL PROBLEMS BY MOTOR PLOT SCORES*

Problem	Episodes	#Episodes	Sol. Code	Range of Scores	Motor Plot Total Score	Initial Score	Final Score	Mean Score
1	1-12	12	1	13-27	216	13	14	18.00
2	13-22	10	1	15-25	191	15	19	19.10
3	23-28	6	1	14-25	105	17	17	17.50
4	29-40	12	1	15-28	231	15	18	19.25
5	41-53	13	3,7	14-31	278	20	23	21.38
6	54-68	15	1	17-32	342	32	19	22.80
7	69-74	6	1	21-27	149	27	26	24.83
8	75-82	8	3	24-32	220	30	29	27.50
9	83-89	7	1	20-27	171	21	27	24.42
TR	90-125	36	6,7	(no verbal or motor data)				
10	127-160	33	1	18-30	512	22	24	23.27
TR	161-166	6	6	21-29	146	29	21	24.33
11	167-173	7	3	21-36	196	21	36	28.00
12	174-187	14	1	24-34	388	27	30	27.71
13	188-212	25	1	22-35	677	25	27	27.08
14	213-236	24	1	21-36	691	24	31	28.79
15	237-242	6	1	25-33	182	25	33	30.33
--	243-249	(incorrectly numbered; no such scores)						
16	250-270	21	1	21-33	616	33	27	29.33
17	271-288	18	1	25-39	569	27	37	31.61
18	289-316	28	3	25-41	860	41	32	30.71
19	317-348	32	1	21-39	952	39	32	29.75
20	349-351	3	1,7	31-33	96	32	31	32.00
21	352-363	12	6,7	24-33	341	33	24	28.41
22	365-384	21	3	22-39	634	27	30	30.19
23	385-398	14	3	27-41	458	33	39	32.71
24	399-427	29	1	22-39	926	36	33	31.93
TR	428-441	14	6,7	30-39	505	33	33	36.07
25	442-503	62	1	23-39	1944	32	33	31.35
26	504-545	42	3,7	23-44	1350	33	31	32.14
27	546-590	45	1,7	21-39	1226	25	32	27.24

*The key for abbreviations and symbols is found in Appendix VI.

APPENDIX XXXVII

Subject 3: ANALYSIS OF HIGHEST SCORES DURING EACH PROBLEM*

Problem	Episode	Score	Analysis of Verbal Data Around Highest Score	Result
1	4	27	Goal = toss--vertical positions	+-
2	19,20	25	"I'm not sure where the starting position is."	+?
3	25	25	NC, goal: C	+
4	38	28	Goal: hit it instead of batting it.	+
5	52	31	Goal: hit it instead of bat it.	+
6	54	32	Goal: ACC	+
7	69,70	27	Goal: ACC & SPD, T, W	A/E and adding vars.
8	80	32	NC, Goal: T, SPD, TIM (77)	
TR	86,87	27	Knees, feet, and P	Comb. vars.
TR			NC	
10	157	30	Knees, RCM, Goal: more push or force	+, Comb. vars.
TR	161	29	NC	larger goal
11	173	36	Goal: ACC	+
12	178	34	NC, certain @ of batting ball into the ground (179)	+
13	208	35	NC, Goals: T, ↑SPD, ↑ACC, choosing between 2 T's	Comb. vars.
14	231	36	NC; trying to lower the T, same as Problem 13	Comb. vars.
15.	239-242	33	P + ↓SPD + T. Adding vars.	Comb. vars.
16.	scattered	33	T + CONT + TIM. "I think it is just luck when I get it in the right position."	Comb. vars.
17	285,6	39	↓ SPD + T + SWING = ACC + SPD or WS	into larger elem.
18.	289	41	NC. Same as Problem 17	"
19.	317	39	T + C = ACC	A/V, Com. of vars. A/E
20.	350	33	NC. T_3= -ACC; T_2= +ACC but -comfort. Goal: find the best between these two	A/V,A/E
21	352,3	33	NC. Same as problem 20.	
22	380	39	NC. T higher (381)	testing

*Abbreviations and symbols are found in Appendix VI.

APPENDIX XXXVII (continued) *

Problem	Episode	Score	Analysis of Verbal Data Around Highest Score	Result
23	390	41	NC. Test T (391)	testing
24	scattered	39	Goal: ACC = S + P + E + T + C (hitting it in different places) + G + RCH	Comb. vars. New props & elem.
TR	scattered	39	NC. Same as Problem 24.	?
25	458,61,86	39	Goal: SPD(452); TIM(459) ACC(459) Same problem as in Problem 13	Narrowing goal
26	520	44	NC	
27	554-578	39	Goal: testing T (566); testing C	Narrowing goal

*Abbreviations and symbols are found in Appendix VI.

APPENDIX XXXVIII

Subject 3: INCREASES AND DECREASES IN MOTOR PERFORMANCE SCORES WITHIN AND BETWEEN DAYS

Days	Increases	Decreases	Scores Remaining The Same	Total
Between	1 (16.66%)	4 (66.66%)	1 (16.66%)	6
Within	9 (40.90%)	8 (36.66%)	5 (22.72%)	22
Total	10 (35.71%)	12 (42.85%)	6 (21.42%)	28

APPENDIX XXXIX

Subject 3: THE EFFECTS OF REST UPON THE WITHIN DAY INCREASES AND DECREASES OF MOTOR PERFORMANCE SCORES

Increases with Rest	Increases Without Rest	Decreases With Rest	Decreases Without Rest	Stays Same With Rest	Stays Same Without Rest	Total
3 (13.63%)	6 (27.27%)	1 (4.54%)	7 (31.81%)	0 (00.00%)	5 (22.72%)	22
Total	9 (40.90%)		8 (36.36%)		5 (22.72%)	22

APPENDIX XL

Subject 3: ANALYSIS OF VERBAL PROBLEMS BY ACCURACY/SPEED SCORES

Prob-lem	#Epi-sodes	Raw Score Accuracy	Raw Score Speed	Accuracy Ratio (6 max)	Speed Ratio (4 max)	Sol. Code[a]
1	12	4	7	.33	.58	1
2	10	5	4	.50	.40	1
3	6	6	5	1.00	.83	1
4	12	8	6	.66	.50	1
5	13	20	9	1.53	.69	3,7
6	15	12	8	.80	.53	1
7	6	1	1	.16	.16	1
8	8	3	5	.37	.62	3
9	7	4	3	.57	.42	1
TR	36	18	18	.50	.50	6,7
10	33	32	15	.96	.45	1
TR	6	3	2	.50	.33	6
11	7	2	2	.28	.28	3
12	14	29	14	2.07	1.00	1
13	25	19	12	.76	.48	1
14	24	26	13	1.08	.54	1
15	6	6	2	1.00	.33	1
16	21	18	12	.85	.57	1
17	18	5	5	.27	.27	1
18	28	32	22	1.14	.78	3
19	32	20	19	.62	.59	1
20	3	7	4	2.33	1.33	1,7
21	12	14	11	1.16	.91	6,7
22	21	16	7	.76	.33	3
23	14	2	2	.14	.14	3
24	29	17	8	.58	.27	1
TR	14	10	7	.71	.50	6,7
25	62	38	27	.61	.43	1
26	42	31	26	.73	.61	3,7
27	45	24	21	.53	.46	1,7

[a] See Appendix XI for a key to the symbols and abbreviations.

APPENDIX XLI

Subject 3: INCREASES AND DECREASES IN ACCURACY AND SPEED SCORES WITHIN AND BETWEEN DAYS

ACCURACY

Days	Increases	Decreases	Scores Remaining The Same	Total
Between	1 (16.66%)	2 (33.33%)	3 (50.00%)	6
Within	5 (21.73%)	4 (17.39%)	14 (60.86%)	23
Total	6 (20.68%)	6 (20.68%)	17 (58.62%)	29

SPEED

Days	Increases	Decreases	Scores Remaining The Same	Total
Between	2 (33.33%)	1 (16.66%)	3 (50.00%)	6
Within	3 (13.04%)	4 (17.39%)	16 (69.56%)	23
Total	5 (17.24%)	5 (17.24%)	19 (65.51%)	29

APPENDIX XLII

Subject 3: THE EFFECTS OF REST UPON THE WITHIN-DAY INCREASES AND DECREASES OF ACCURACY AND SPEED SCORES

ACCURACY

Increase With Rest	Increase Without Rest	Decrease With Rest	Decrease Without Rest	Stays Same With Rest	Stays Same Without Rest	Total
1 (4.34%)	4 (17.39%)	1 (4.34%)	3 (13.04%)	7 (30.43%)	7 (30.43%)	23
Total	5 (21.73%)		4 (17.39%)		14 (60.86%)	23

SPEED

Increase With Rest	Increase Without Rest	Decrease With Rest	Decrease Without Rest	Stays Same With Rest	Stays Same Without Rest	Total
0 (00.00%)	3 (13.04%)	0 (00.00%)	4 (17.39%)	5 (31.25%)	11 (47.82%)	23
Total	3 (13.04%)		4 (17.39%)		16 (69.56%)	23

APPENDIX XLIII

Subject 4: HEWITT SERVE TEST SCORE ANALYSIS

Day	EPS	Raw Accuracy Score	Raw Speed Score	T-Score Accuracy	T-Score Speed
1	34-43	10	6	65	60
2	145-154	9	3	64	51
3	220-229	14	7	74	60
4	320-329	18	12	80+	75
5	397-406	7	4	60	53
6	478-487	6	3	58	51
7	522-531	10	6	65	60

APPENDIX XLIV

Subject 4: ACCURACY-SPEED MEAN DAILY SCORES

Day	#of Serves	Raw Accuracy Scores	Raw Speed Scores	Mean Accuracy	Mean Speed
1	43	13	10	.30	.23
2	111	93	44	.85	.39
3	75	80	54	1.06	.72
4	100	101	69	1.01	.69
5	77	89	66	1.15	.85
6	81	76	55	.93	.67
7	44	85	44	1.93	1.00
Total	531	537	342	7.23	4.55

Average daily accuracy = 1.03
Average daily speed = .65

APPENDIX XLV

ORDER SUBJECT 4 READS IN VARIABLES, PROPERTIES AND ELEMENTS

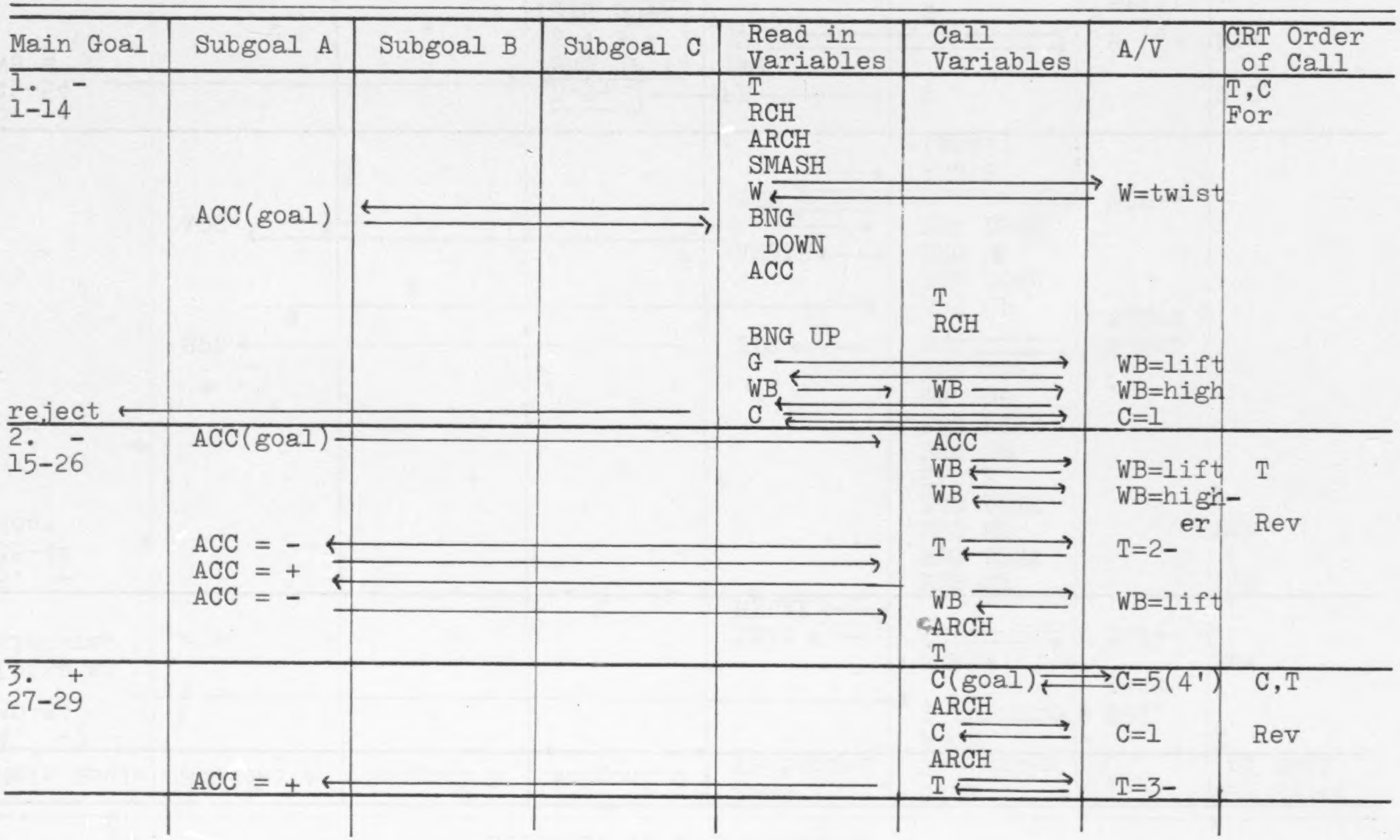
1. T = vertical position of toss
2. RCH = reach
3. ARCH
4. SMASH
5. WRIST = twisted, A/V
6. BNG DOWN = bring racket down
7. ACC = accuracy
8. BNG UP = bring racket up
9. G = grip racket tighter, A/V
10. WB = lift whole body
11. C = horizontal position of toss
    (C = 1 A/V)
    (C = 5 A/V, +)
    (T = 2 A/V, -)
    (T = 3 A/V, -)
    (T = 1 A/V, -)
12. LEAN
13. RELAX
14. SPD = speed, force
    (G = too tight, A/V)
15. ANGLE = increase, A/V, +)
16. TOP = come over the top of the ball, -
17. B = backswing
18. FS = forward swing
19. S_{13} = feet still
20. S_{10} = on toes (reverse of flat-footed)
21. TIM = timing
    (C = 2, A/V, -)
22. SWAY
23. R = position of face of the racket
24. FEEL
    (S = flat-footed, A/V to S_{10})
25. F = "come through with them"
    (TIM = too soon, A/V)
    (R = R_1 flat, straight on; A/V)
    (T = T_2 elbow bent, A/V, +)
26. THINK
    (C = C_4, A/V, -)
27. G = thumb in
28. OC = on center of the racket
29. E = elbow up, A/V, +)
30. DOA = hit down off arm
    (R = angle between flat and twisted face, A/V, +)
31. H = waiting position
    (BNG DOWN = too far, A/V)
32. WIND
    (C = C_1, A/V, +)

APPENDIX XLV (continued)

33. P = body position
34. CON = control over the racket
    (C = C_1, A/V, -)
    (C = C_3, A/V, +)
35. WS = natural, smooth stroke, A/V, +
    (T = drops, get as it comes down T=2, A/V, +)
    (G = G_1, A/V, +)
    (TIM = slower come on, A/V, +)

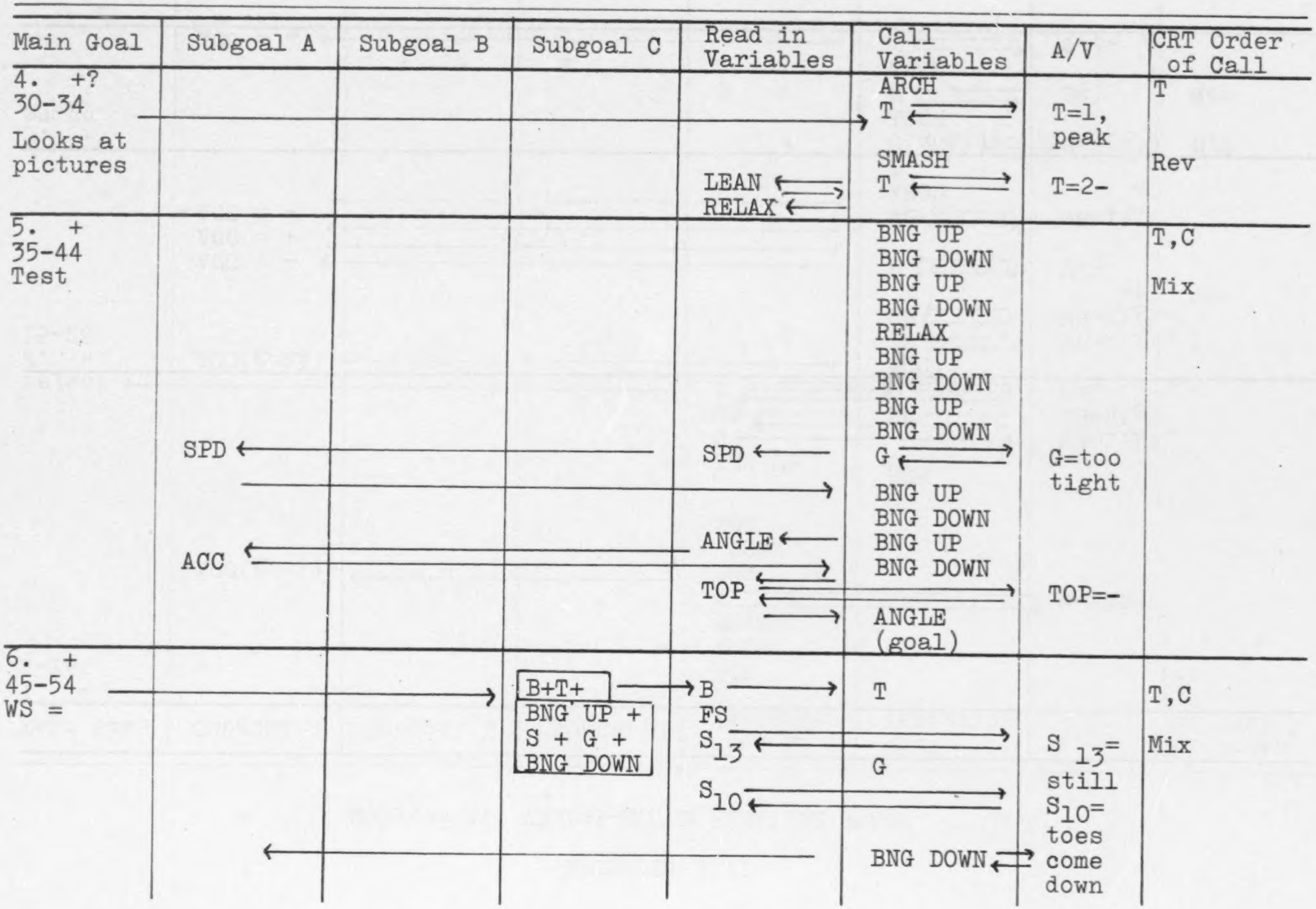
APPENDIX XLVI

Subject 4: VERBAL-MOTOR BEHAVIOR GRAPH



Main Goal	Subgoal A	Subgoal B	Subgoal C	Read in Variables	Call Variables	A/V	CRT Order of Call
1. -				T			T,C
1-14				RCH			For
				ARCH			
				SMASH			
				W		W=twist	
	ACC(goal)			BNG			
				DOWN			
				ACC			
					T		
					RCH		
				BNG UP			
				G		WB=lift	
				WB	WB	WB=high	
reject				C		C=1	
2. -	ACC(goal)				ACC		
15-26					WB	WB=lift	T
					WB	WB=higher	Rev
	ACC = -				T	T=2-	
	ACC = +						
	ACC = -				WB	WB=lift	
					ARCH		
					T		
3. +					C(goal)	C=5(4')	C,T
27-29					ARCH		
					C	C=1	Rev
					ARCH		
	ACC = +				T	T=3-	

APPENDIX XLVI (continued)



Main Goal	Subgoal A	Subgoal B	Subgoal C	Read in Variables	Call Variables	A/V	CRT Order of Call
4. +? 30-34 Looks at pictures				LEAN ⇄ RELAX ←	ARCH T ⇄ SMASH T ⇄	T=1, peak T=2-	T Rev
5. + 35-44 Test	SPD ← ACC ←			SPD ← ANGLE ← TOP ⇄	BNG UP BNG DOWN BNG UP BNG DOWN RELAX BNG UP BNG DOWN BNG UP BNG DOWN G ⇄ BNG UP BNG DOWN BNG UP BNG DOWN ANGLE (goal)	G=too tight TOP=-	T,C Mix
6. + 45-54 WS =			B+T+ BNG UP + S + G + BNG DOWN	B → FS S_{13} ⇄ S_{10} ⇄	T G BNG DOWN ⇄	S $_{13}$= still S_{10}= toes come down	T,C Mix

APPENDIX XLVI (continued)

Main Goal	Subgoal A	Subgoal B	Subgoal C	Read in Variables	Call Variables	A/V	CRT Order of Call
					ARCH ⇄	right over wait too long	
	SPD = - ACC = - →	TIM →	→	TIM →	S_{13} ⇄		
		TIM ←	←	←	TIM		
		→	→	→	BNG UP		
					BNG DOWN		
					S_{13}		
					C ⇄	C=2-	
					TIM		
			HIT=right over ARCH + T + C + TIM		BNG DOWN		
					C		
				←	RELAX		
7. + 55-80	SPD = -				T		T,C,R
	←	←	←	←	SPD		
	→	→	→	→	RELAX	"nice & easy" ? "can't figure"	
WS = ←	←	←	←	SWAY ←			
"can't →	→	→	→	→	C		
figure it out.. the movement"	ACC(goal) ←	TIM ←	TIM + RELAX = ACC ←	←	RELAX		For
	SPD = - →	→	→	→	SPD ANGLE		
	ACC = - ←	←	←	R ←			
	ACC = - →	FEEL →	→	→	→	"feel of it"	
	ACC(goal) ←	←	←	←	←		
	ACC = to R. →	→	→	→	→	to R.	
	ACC = -to L. ←	←	←	←	←	to L.	
	ACC = + →	→	→	→	W ⇄	turned, in cen.	

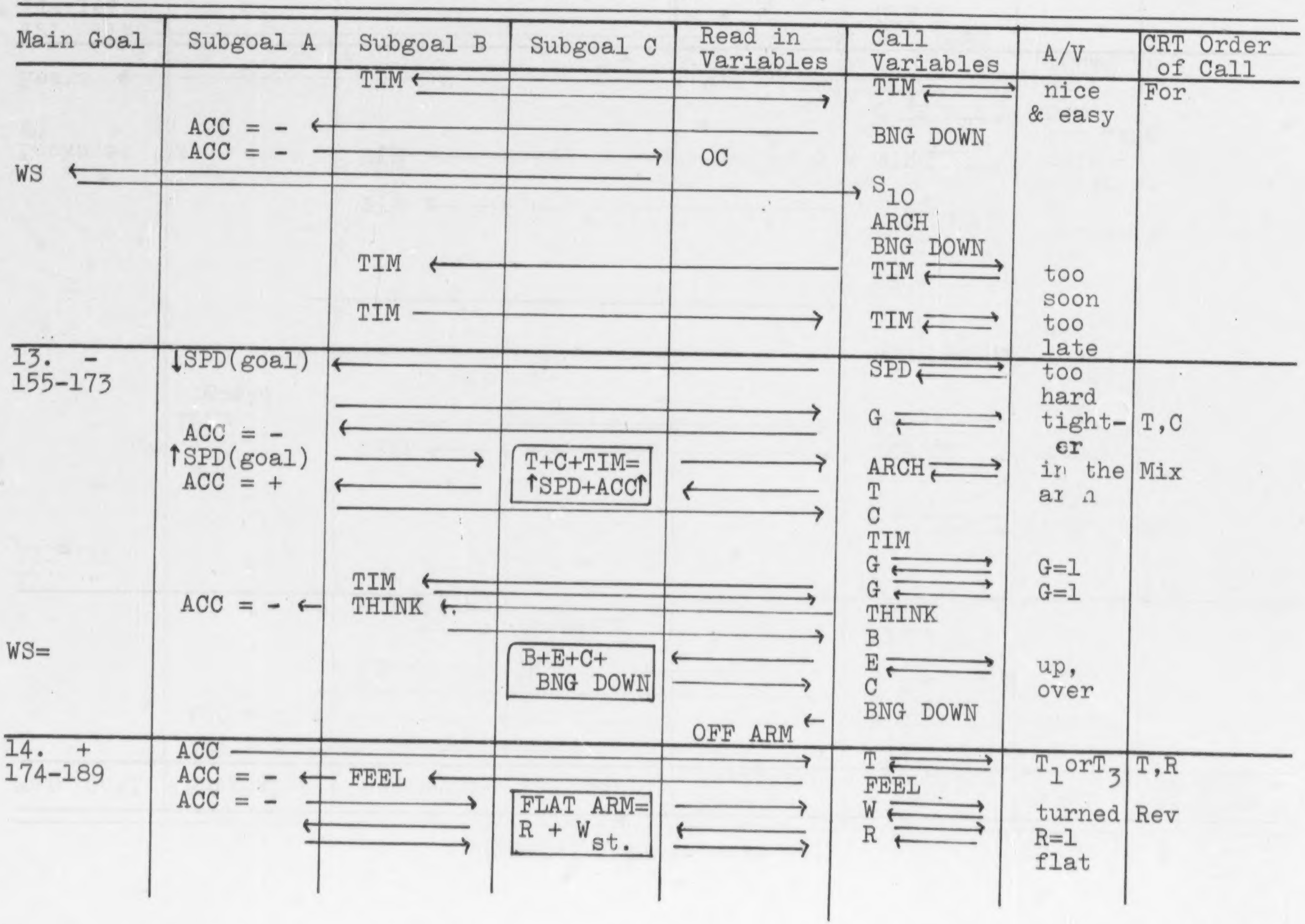
APPENDIX XLVI (continued)

Main Goal	Subgoal A	Subgoal B	Subgoal C	Read in Variables	Call Variables	A/V	CRT Order of Call
		FORM first then SPD (goal)	←		G C ⇄ B	C=5	
8. ? 81-104	↑SPD(GOAL) ← ACC = - ← → ↓SPD (goal) ← → ACC/SPD (goals) ←	TIM ← →		S_{flat} ⇄ ← F → ←	ARCH S_{10} SPD C ⇄ T ⇄ TIM ⇄ T ⇄ ANGLE RELAX ⇄ W ⇄ R ⇄	S=flat footed C=5 T=3 too soon T=2 "nice & easy" turned R=1	C,T,R For, Mix
9. - 105-108		TIM ← →	T+C+TIM= over the ARCH	← →	W ⇄ R ⇄ ARCH ⇄ TIM T C	turned R=1 Over the	R,T,C Rev
10. -? 109-122	ACC = - ← ↑ACC(goal) → ← ⇄	→ THINK ⇄	↑ACC = R_1 → (A/E) ←		G ⇄ W R ⇄	G=1 turned R=1 TK=-	R,T For

APPENDIX XLVI (continued)

Main Goal	Subgoal A	Subgoal B	Subgoal C	Read in Variables	Call Variables	A/V	CRT Order of Call
	SPD = - →				S_{10}		
	ACC = - ←				W ⇄	turned	
	→				T ⇄	T=2	
		TIM ←	$\boxed{R_2 = T_2 \; (A/E)}$ ←		R ⇄	R=2	
		→	→		TIM		
		THINK ←			THINK		
11. - 123-142					S_{10}		T,C
					T		
					C ⇄	C=5	Rev
					W	turned	
					G ⇄	G=1	
		FEEL ←			FEEL ⇄	funny	
		TIM →			TIM ⇄	wait too long	
	↓SPD (goal)						
	←				BNG DOWN ⇄	too hard	
	→				F		
					ARCH		
					T ⇄	T=2	
					T ⇄	T=1 or 3	
		TIM ←			TIM ⇄	go after it	
Looks at WS		TIM →			TIM ⇄	wait too long	
					C ⇄	C=4-	
Rests ←				G_{thumb} ⇄		G= thumb in	
12. +?WS → 143-154					BNG DOWN RELAX		-

APPENDIX XLVI (continued)



Main Goal	Subgoal A	Subgoal B	Subgoal C	Read in Variables	Call Variables	A/V	CRT Order of Call
		TIM ←			TIM ⇄	nice & easy	For
	ACC = - ←				BNG DOWN		
	ACC = - →			OC			
WS ←							
→					S_{10}		
					ARCH		
					BNG DOWN		
		TIM ←			TIM ⇄	too soon	
		TIM →			TIM ⇄	too late	
13. - 155-173	↓SPD(goal) ←				SPD ⇄	too hard	
		→			G ⇄	tight-er	T,C
	ACC = -	←					
	↑SPD(goal)	→	T+C+TIM= ↑SPD+ACC↑	→	ARCH ⇄	in the arm	Mix
	ACC = +	←		←	T		
		→			C		
					TIM		
		TIM ←			G ⇄	G=1	
					G ⇄	G=1	
	ACC = - ←	THINK ←			THINK		
		→			B		
WS=			B+E+C+ BNG DOWN	← →	E ⇄	up, over	
					C		
				OFF ARM ←	BNG DOWN		
14. + 174-189	ACC →				T ⇄	T_1 or T_3	T,R
	ACC = - ←	FEEL ←			FEEL		
	ACC = -	→	FLAT ARM= R + $W_{st.}$	→	W ⇄	turned	Rev
		← →		← →	R ⇄	R=1	
						flat	

APPENDIX XLVI (continued)

Main Goal	Subgoal A	Subgoal B	Subgoal C	Read in Variables	Call Variables	A/V	CRT Order of Call
	ACC = + ←	←	←	←	W ⇄	W= straight+	
rests	↑ACC(goal) →	→	→	→	R		
15. +? 190-218	↑ACC(goal) →	→	→	→	WB ⇄ G ⇄	lift tight-er	R,C,T
	ACC = -	←	←	←	RCH		Mix
		→	→	→	R ⇄	R=1 of arc	
	ACC = -	←	←	←	TOP ⇄		
		→	→	→	C ⇄	C=1	
		TIM ←	$C_1 + T_1 +$ TIM + TOP of arc=ACC	←	T ⇄	T=1 Top of arc	
		THINK →	→	→	TIM ⇄		
					THINK		
16. - WS ←	←	←	B+E+C+T ←	←	R		R,C,T Mix
219-230 →	→	→	→	→	B E C T		
	←	←	←	←			
	ACC = - →	TIM →	+ TIM →	→	W ⇄	Twist	
		←	←	←	TIM		
	↑ACC(goal)	→	→	→	ANGLE		
			Between R_1 & R_{twist} (test)	←	R ⇄ R ⇄	R=1 R= twist	
				→			
WS "put every-thing together"	↑ACC(goal) ←	THINK ←	←	←	THINK		
	ACC = -						
←	ACC = -						

APPENDIX XLVI (continued)

Main Goal	Subgoal A	Subgoal B	Subgoal C	Read in Variables	Call Variables	A/V	CRT Order of Call
17. - 233-263 WS(goal)	———	———	———	———→	G ⇄	tight	
					T ⇄	T_1 or T_3	T,C
					S_{10}		For
					Relax		
			T lower = ACC (A/E)	←———	T ⇄	T_1 orT_3	
				———→	S_{13}		
					T ⇄	T=1	
	←———	———	———	———	C		
					T		
	ACC/SPD (goal)	TIM ⇄	———	———→	TIM ⇄	in arc	
	ACC = + ———	———	———	———→	T ⇄	T=2-	
	ACC = + ←	— THINK ←	———	———	THINK		
	———	———	———	———→	G		
	ACC = - ←	———	———	———	S_{13}		
	———	———	———	———→	G ⇄	firm	
					F		
					G ⇄	tight	
					T ⇄	T=1	
					G ⇄	tight	
					C ⇄	C=2	
		TIM- ←	———	———	TIM		
		FEEL -	———	———→	FEEL		
18. - 264-269 WS =	———	———	———→	H ———→	BNG DOWN		C,T,R
					B		For
			B+FS+ARCH +C+T+		FS		
				←———	ARCH		
				———→	C		
		TIM ←———	TIM ←	———	T		
		———	———	———→	TIM		

APPENDIX XLVI (continued)

Main Goal	Subgoal A	Subgoal B	Subgoal C	Read in Variables	Call Variables	A/V	CRT Order of Call
					C ⇄	over-	
						head	
					R ⇄	turn	
		TIM ←			TIM ⇄	wait too	
						long	
		→			T ⇄	T=3	
WS = -					S_{10}		
←		←			ARCH		
→		FEEL - →			FEEL		
19. -	ACC(goal ←				BNG DOWN		
270-275	→				F		
	↓S.PD ←				G ⇄	tight	- Mix
	→				SPD ⇄	too	
					E	hard	
20. -		FEEL ←			B		
276-278		→			FEEL ⇄	right	-
		TIM ←			TIM ⇄	wait	For
		→			OC	too	
	ACC = - ←				BNG DOWN	long	
21. -+	ACC = - →				S_{10}		
279-287					ARCH		T,C
	↓SPD(goal) ←				T ⇄	T=1	
	→				RELAX		Mix
	ACC = - ←	THINK ←			THINK		
	ACC = - →				G ⇄	tighter	
					S		
					H		
		TIM ⇄			TIM ⇄	in arc	
	ACC = - ←		C+T+TIM = ACC	←	C		
	→			→	T		

APPENDIX XLVI (continued)

Main Goal	Subgoal A	Subgoal B	Subgoal C	Read in Variables	Call Variables	A/V	CRT Order of Call
22. - 288-291		CON ←	—	—	CON ⇄	CON=-	
		—	—	→	R		
		←	—	—	G ⇄	tight-er	R
		TIM →	—	→	TIM ⇄	too soon	Rev
					TIM ⇄	too late	
	ACC = - ←	FEELS ←	—	—	FEELS ⇄	awkward	
23. -? 292-304	ACC = -	—	—	→	RELAX		R
	←	—	—	—	G ⇄	tight-er	
		—	—	→			
					BNG DOWN ⇄	over	
	ACC = - ←	—	—	—	R		
		—	—	→	ARCH		
					G		
					S ⇄	S=flat-	
		TIM ←	—	—	TIM ⇄	wait too long	
		—	—	→			
	↓SPD(goal)				TIM ⇄	too late	
	SPD = - ←	—	—	—	SPD ⇄	too hard	
24. -? 305-329	ACC = -						
	ACC = -						
	ACC = -	—	—	→	RELAX		-
	←	THINK ←	—	—	THINK		Mix
	ACC = +	—	—	→	G		
WS ←	—	—	—	—	RELAX		
(goal) →	ACC(goal)						

APPENDIX XLVI (continued)

Main Goal	Subgoal A	Subgoal B	Subgoal C	Read in Variables	Call Variables	A/V	CRT Order of Call
25. – 330-343				WIND →	G ⇄	tight-er	R,C
	ACC = + ←			←	R		
	→	FEELS →		→	FEELS ⇄	awk-ward	
					WB ⇄	lift	For
					BNG DOWN		
					G ⇄	tight-er	
		TIM ←		←	TIM ⇄	wait too long in corner	
		→		→			
	ACC = + ←			←	S_{10}		
	→			→			
					WB ⇄	lift	
					C ⇄	C=2	
					C ⇄	C=1	
26. – 344-363				P →			T
		TIM ←		←	TIM ⇄	wait too long	
		→		→	T		
	ACC = – ←	TIM ←		←	TIM ⇄	wait too long	Rev, Mix
	→			→	R ⇄	R= twist-	
					G ⇄	tight-er	
WS = ←				←	S_{10}		
→				→	G		
			$G+WB_{lift}^{+}$ T=↑ACC	←	WB ⇄	lift	
				→	T		

APPENDIX XLVI (continued)

Main Goal	Subgoal A	Subgoal B	Subgoal C	Read in Variables	Call Variables	A/V	CRT Order of Call
	↑ACC(goal) ←				Lean		
	"aim" →			→	WB ⇄	lift	
	←			→	Smash		
	ACC = -		G+S_{13}^{+}	←	G ⇄	tight-er	
			WB_{lift}^{+}	→	S_{13}		
			ARCH=ACC↑	← →	WB ⇄	lift	
					ARCH		
27. +					F		R,C
364-375					R		Mix
		BAL ← →		BAL ← →	W(goal) ⇄	twist	
					WIND		
					G ⇄	tight-er	
					RELAX		
WS = ← →				→	W ⇄	twist	
"put whole					C ⇄	C=1-	
thing					C ⇄	C=3+	
together"							
28. +					T ⇄	T=3	
376-384					WB ⇄	lift	T,R
	↑SPD ←				WIND		Mix
WS =	ACC = - →			→	G ⇄	tight	
"get ←					R		
every-							
thing in							
order"							
29. -		BAL ←			BAL		
385-402		→		→	T ⇄	T=3	T,R
					S_{13}		
					T ⇄	T=1	Mixed
					G ⇄	tight	

APPENDIX XLVI (continued)

Main Goal	Subgoal A	Subgoal B	Subgoal C	Read in Variables	Call Variables	A/V	CRT Order of Call
	ACC = - ←				WB ⇄	lift	
	→	COOR			COOR ⇄	natural,	
WS = ←	ACC = - ←					smooth	
→	→	COOR →	COOR=ACC →	→	COOR ⇄	stroke	
					F		
	←				G ⇄	tight-er	
	ACC = ? →			→	RELAX		
	ACC = - ←				R		
	ACC = - ↓						
30. -? Test 403-406	SPD = - ←				G ⇄ S_{10}	tighter For	-
31. - 407-413	ACC = - →			→	G ⇄	tight-er	T
WS (goal) "put everything together"	ACC = - ←				T ⇄	T=2+	1 var. only
	→				→	long	early var.
32. -? 414-419	ACC = - →			→	WB ⇄	lift	
					G ⇄	tight-er	T
					G ⇄	G=1	
					WB ⇄	lift	Rev
					WB ⇄	lift	
					G ⇄	tight-er	
	ACC = - ←				T ⇄	T=3	
33. -? 420-425	ACC = - ⇄				G		-
	→			→	BNG DOWN		Rev
	ACC = - ←				ARCH		

APPENDIX XLVI (continued)

Main Goal	Subgoal A	Subgoal B	Subgoal C	Read in Variables	Call Variables	A/V	CRT Order of Call
34. - 426-445	ACC = - ←	← FEEL ←			FEEL ⇄	good	-
	→			→	RCH		For
	ACC = - ←		ACC =WB_{lift}^{+} RCH	←	WB ⇄	lift	
	↑ACC(goal)	→		→	ARCH ⇄	down the middle+	
	ACC = - ←						
	ACC = - →			→	WIND ⇄	too hard	
	ACC = - ←				W ⇄	turned-	
	ACC = - ←			→	G ⇄	tightor	
	→			→	W ⇄	turned-	
					S_{13} ⇄	feet still	
	↑SPD(goal) ←	TIM ←	↑SPD=ACC↓ (A/E)	←	TIM ⇄	wait too long	
35. - 446-454	ACC = - ←				G ⇄	tight-er	-
	→			→	WB ⇄	lift	
	ACC = - ←				ARCH		
	→			→	G ⇄	tight-er	Mix
		THINK ←			THINK		
		→		→	S_{10} ⇄	flat	
	ACC = - ←		↑ARCH=↑ACC	←	ARCH		
36. ? 455-475	→			→	WB ⇄	Lift	-
					WB(goal) ⇄	lifting	
	ACC = - ←				S_{10} ⇄	flat	For
	→			→	F		
					BNG DOWN		

APPENDIX XLVI (continued)

Main Goal	Subgoal A	Subgoal B	Subgoal C	Read in Variables	Call Variables	A/V	CRT Order of Call
WS = ← →			$\boxed{\text{BNG DOWN+ ARCH+TOP}}$	← →	F W ⇄ BNG DOWN TOP	twist	
37. ?Test 476-487	ACC = - ← →	TIM ←			BNG ⇄ RELAX ⇄ TIM ⇄	over long slower come down	- For
38. + 488-515 looks at pictures WS="put ← everything together"					ARCH ⇄ F WB ⇄ G ⇄ S_{13}	arch lift tight-er	- Mix
39. -Test → 516-531 WS= "everything together"	ACC = - ← → ACC = - ← →				G ⇄ WB ⇄ ACC ⇄ S ⇄ BNG DOWN S ⇄ WIND F	tight-er lift long stance Flat	- For Mix

APPENDIX XLVII

Subject 4: SYNOPSIS OF VERBAL-MOTOR BEHAVIOR GRAPH

-	- +	?		+	+ -
CRT	Order of Call	CRT	Order of Call	CRT	Order of Call
1. T,C	For	8. C,T,R	Mix	3. C,T	Rev
2. T	Rev	36. -	Mix	4. T	Rev
9. R,T,C	Rev	37. -	For	5. -	Mix
10. R,T	For			6. T,C	Mix
11. T,C	Mix			7. T,C,R	For
13. T,C	Mix			12. -	For
16. R,C,T	Mix			14. T,R	Rev
17. T,C	For			15. R,C,T	Mix
18. C,T,R	For			27. R,C	Mix
19. -	Mix			28. T,R	Mix
20. -	Mix			38. -	Mix
21. T,C	Mix				
22. R	Rev				
23. R	Rev				
24. -	Mix				
25. R,C	For				
26. T	Mix				
29. T,R	Mix				
30. -	For				
31. T	(only 1 var.)				
32. T	Rev				
33. -	Rev				
34. -	For				
35. -	Mix				
39. -	Mix				
TOTALS T = 4 R = 2 RC = 1 TC = 5 RT = 1 TR = 1 RTC=1 RCT=1 CTR=1	Rev = 6 For = 7 Mix = 11	CTR = 1	Rev = 0 For = 1 Mix = 2	T = 1 TC = 1 CT = 1 TR = 2 RC = 1 TCR = 1 RCT = 1	Rev = 3 For = 2 Mix = 6

APPENDIX XLVIII

Subject 4: ANALYSIS OF VERBAL PROBLEMS BY MOTOR PLOT SCORES *

Problem	Episodes	#Episodes	Sol. Code	Range of Scores	Motor Plot Total Score	Initial Score	Final Score	Mean Score
1	1-14	14	2	42-61	737	58	47	52.64
2	15-26	12	2	36-54	546	50	36	45.50
3	27-29	3	3	43-52	141	46	52	47.00
4	30-34	5	3	39-45	206	39	45	41.20
5	35-43	9	3,7	39-58	414	42	39	46.00
6	44-54	11	3	41-60	521	41	41	47.36
7	55-80	26	3	37-52	1151	43	51	44.26
8	81-104	24	1	34-63	1136	51	47	47.33
9	105-108	4	2	39-49	182	48	49	45.50
10	109-122	14	2	42-63	716	42	57	51.14
11	123-142	20	2	45-53	989	51	53	49.45
12	143-154	12	3,7	45-63	623	49	48	51.91
13	155-173	19	2	45-63	986	51	54	51.89
14	174-189	16	3	42-54	763	48	42	47.68
15	190-218	29	3	37-60	1384	51	37	47.72
16	219-229	11	2,7	44-56	531	44	45	48.27
17	230-263	34	2	37-62	1589	42	38	46.73
18	264-269	6	2	42-63	293	47	48	48.83
19	270-275	6	2	37-60	282	54	40	47.00
20	276-278	3	2	45-54	150	54	45	50.00
21	279-287	9	4	37-54	422	44	37	46.88
22	288-291	4	2	45-53	197	48	51	49.25
23	292-304	13	2	39-54	607	48	54	46.69
24	305-329	25	2,7	34-51	1034	34	47	41.36
25	330-343	14	3	32-63	675	44	34	48.21
26	344-363	20	2	34-54	919	37	54	45.95
27	364-375	23	3	31-51	513	51	39	42.75
28	376-384	9	3	34-45	366	34	45	40.66
29	385-402	18	2	31-51	755	45	45	41.94

APPENDIX XLVIII (continued)*

Problem	Episodes	#Episodes	Sol. Code	Range of Scores	Motor Plot Total Score	Initial Score	Final Score	Mean Score
30	403-406	4	2,7	42-48	177	48	42	44.25
31	407-413	7	2	40-48	319	48	40	45.57
32	414-419	6	2	39-47	265	44	39	44.16
33	420-425	6	2	42-48	276	42	47	46.00
34	426-445	20	2	34-54	889	47	40	44.45
35	446-454	9	2	36-51	394	51	44	43.77
36	455-475	21	1	34-60	983	41	51	46.80
37	476-487	12	1,7	37-51	554	45	54	46.16
38	488-515	28	3	40-60	1380	54	54	49.28
39	516-531	16	2,7	36-54	776	45	44	48.50

*The legend for abbreviations and symbols is found in Appendix VI.

APPENDIX XLIX

Subject 4: ANALYSIS OF HIGHEST SCORES DURING EACH PROBLEM

Problem	Episode	Score	Analysis of Verbal Data Around Highest Score	Result
1	10	61	Goal: lift whole body	+
2	21	54	Goal: lift +T	+ Comb. values
3	29	52	"There you go getting closer" = T	+ A/E
4	34	45	T + RELAX + TIM (take it slow)	- Comb. Vars.
5	36	58	T	-
6	47	60	TIM + T	- Comb. Vars.
7	59	52	NC. ↓SPD	+
8	89,100	63	TIM=T+BALLTOSS+ANGLE+RELAX+R	+ Comb. Vars.,A/E single vars. larger scope
9	108	49	G	-, +
10	111	63	G	+
11	141,2	53	WB = G+T+G_{thumb}+TIM+E+ARCH + ↓SPD+F+$UP_{on\ toes}$	single vars. A/E, larger scope comb. into larger elem.=WB
12	145	63	NC "Bring them down."	+
13	171	63	WB = "the movement, back and over (168,172)	comb. into, A/E elems. +
14	184	54	FLAT ARM = E,R	+, A/E
15	211	60	"hum," "a little flatter (207)	+
16	223	56	"I'm trying to find the angle between the flat side and the turned side" (219) R	testing R
17	254	62	ACC = -; G + S (250)	-, narrowing, A/E
18	267	63	TIM = RCH + S + ARCH	A/E,Comb.
19	272	60	NC. R + F	+ Narrowing
20	276	54	B + FEELS = WS	+ Narrowing, A/E into elems.

APPENDIX XLIX (continued)

Problem	Episode	Score	Analysis of Verbal Data Around Highest Score	Result
21	283-5	54	ACC = G+S+P+go through the arc	+,adding vars., A/E
22	290	53	NC	-
23	304	54	↓SPD. "You've got to save the hardness until after you learn it right."	narrows goal +
24	321	51	Nervous.	Testing, +
25	337	63	HD	Narrows goal,1 prop.,+
26	363	54	CONT+ACC+G+F+R+W	Comb. vars., adding vars.
27	364,374	51	RELAX, "Put them together"= WS	A/E, comb. into elem.+
28	381,4	45	R; GOAL: "getting everything right in order"	Comb. vars. into elems. narrowing +
29	387,393	51	NC	
30	403	48	NC	
31	407,8,11	48	ACC = - "let's just get it going""let's just put everything together"	Comb. into elems, narrowing
32	417,18	47	Goal: lift higher	+ 1 goal, return to early goal
33	422,3	48	ACC = -; HD + TIM	- A/E
34	431,35	54	ACC = -	+, 1 early goal
35	446	51	G = tight	+, 1 goal
36	469	60	NC F(467,470)	
37	477,8,80	51	WS, ACC = -, NERVOUS	testing
38	508	60	NC "getting everything together" (507)	1 elem.
39	521-525	54	"Just trying to make it work"	1 elem. narrow.goal

APPENDIX L

Subject 4: INCREASES AND DECREASES IN MOTOR PERFORMANCE SCORES WITHIN AND BETWEEN DAYS

Days	Increases	Decreases	Scores Remaining the Same	Total
Between	3 (50.00%)	2 (33.33%)	1 (16.66%)	6
Within	16 (50.00%)	13 (40.62%)	3 (9.37%)	32
Total	19 (50.00%)	15 (39.47%)	4 (10.52%)	38

APPENDIX LI

Subject 4: THE EFFECTS OF REST UPON THE WITHIN DAY INCREASES AND DECREASES OF MOTOR PERFORMANCE SCORES

Increases With Rest	Increases Without Rest	Decreases With Rest	Decreases Without Rest	Stays Same With Rest	Stays Same Without Rest	Total
1 (3.12%)	14 (43.75%)	3 (9.37%)	11 (34.37%)	1 (3.12%)	2 (6.25%)	32
Total	15 (46.87%)		15 (43.75%)		3 (9.37%)	32

APPENDIX LII

Subject 4: ANALYSIS OF VERBAL PROBLEMS BY ACCURACY/SPEED SCORES

Problem	#Episodes	Raw Score Accuracy	Raw Score Speed	Accuracy Ratio (6 max)	Speed Ratio (4 max)	Sol.Code[a]
1	14	1	2	.07	.14	2
2	12	1	2	.08	.16	2
3	3	0	0	.00	.00	3
4	5	0	0	.00	.00	3
5	9	10	6	1.11	.66	3,7
6	9	4	2	.44	.22	3
7	26	28	11	1.07	.42	3
8	24	14	9	.58	.37	1
9	4	1	1	.25	.25	2
10	14	17	8	1.21	.57	2
11	20	18	8	.90	.40	2
12	12	11	5	.91	.41	3,7
13	19	9	11	.47	.57	2
14	16	16	11	1.00	.68	3
15	29	35	23	1.20	.79	3
16	11	20	9	1.81	.81	2,7
17	34	31	20	.91	.58	2
18	6	1	2	.16	.33	2
19	6	2	2	.33	.33	2
20	3	1	2	.33	.66	2
21	9	12	8	1.33	.88	4
22	4	6	3	1.50	.75	2
23	13	17	7	1.30	.53	2
24	25	31	25	1.24	1.00	2,7
25	14	16	13	1.14	.92	3
26	20	24	20	1.20	1.00	2
27	12	14	12	1.16	1.00	3
28	9	15	6	1.66	.66	3
29	18	20	13	1.14	.72	2
30	4	5	2	1.25	.50	2,7
31	7	13	8	1.85	1.14	2
32	6	3	4	.50	.66	2
33	6	1	2	.16	.33	2
34	20	12	12	.60	.60	2
35	9	3	2	.33	.22	2
36	21	35	22	1.66	1.04	1
37	12	9	5	.75	.41	1,7
38	28	62	32	2.21	1.14	3
39	16	23	12	1.43	.75	2,7

[a] See Appendix VI for the key to the solution codes.

APPENDIX LIII

Subject 4: INCREASES AND DECREASES IN ACCURACY AND SPEED SCORES WITHIN AND BETWEEN DAYS

ACCURACY

Days	Increases	Decreases	Scores Remaining The Same	Total
Between	0 (00.00%)	1 (16.66%)	5 (8.33%)	6
Within	15 (46.87%)	4 (12.50%)	13 (40.62%)	32
Total	15 (39.47%)	5 (13.15%)	18 (47.36%)	38

SPEED

Days	Increases	Decreases	Scores Remaining The Same	Total
Between	0 (00.00%)	0 (00.00%)	6 (100.00%)	6
Within	14 (43.75%)	3 (9.37%)	15 (46.87%)	32
Total	14 (36.84%)	3 (7.89%)	21 (55.26%)	38

APPENDIX LIV

Subject 4: THE EFFECTS OF REST UPON THE WITHIN-DAY INCREASES AND DECREASES OF ACCURACY AND SPEED SCORES

ACCURACY

Increases With Rest	Increases Without Rest	Decreases With Rest	Decreases Without Rest	Stays Same With Rest	Stays Same Without Rest	Total
0 (00.00%)	15 (46.87%)	1 (3.12%)	3 (9.37%)	4 (12.50%)	9 (28.12%)	32
Total	15 (46.87%)		4 (12.50%)		13 (40.62%)	32

SPEED

Increases With Rest	Increases Without Rest	Decreases With Rest	Decreases Without Rest	Stays Same With Rest	Stays Same Without Rest	Total
0 (00.00%)	14 (43.75%)	1 (3.12%)	2 (6.25%)	4 (12.50%)	11 (34.37%)	32
Total	14 (43.75%)		3 (9.37%)		15 (40.87%)	32

APPENDIX LV

Subject 5: HEWITT SERVE TEST SCORE ANALYSIS

Day	EPS	Raw Accuracy Score	Raw Speed Score	T-Score Accuracy	T-Score Speed
1	85-94	6	5	58	58
2	156-165	7	5	60	58
3	213-222	5	6	55	60
4	274-283	3	2	49	46
5	342-351	2	2	48	46
6	421-440	3	3	49	51
7	465-474	11	7	67	63

APPENDIX LVI

Subject 5: ACCURACY-SPEED MEAN DAILY SCORES

Day	#of Serves	Raw Accuracy Scores	Raw Speed Scores	Mean Accuracy	Mean Speed
1	94	90	60	.95	.63
2	71	44	28	.61	.39
3	54	17	14	.31	.25
4	61	15	12	.24	.19
5	68	30	19	.44	.27
6	79	34	25	.43	.31
7	42	34	26	.80	.61
Total	469	267	184	3.68	2.65

Average daily accuracy = .54
Average daily speed = .38

APPENDIX LVII

ORDER SUBJECT 5 READS IN VARIABLES, PROPERTIES AND ELEMENTS

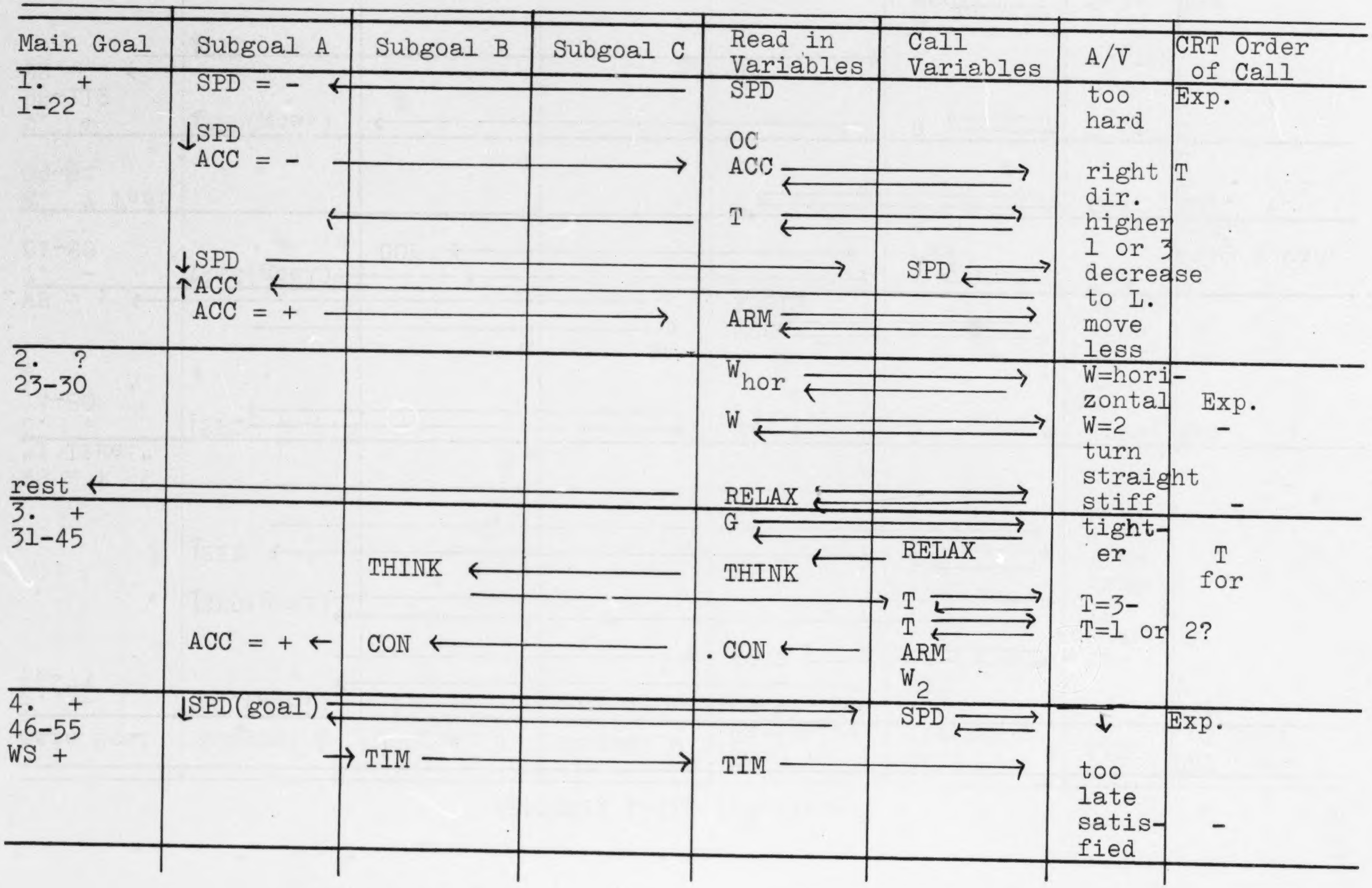
1. SPD = speed
   (SPD = too hard, A/V)
2. OC = on center
3. ACC = accuracy
4. T = vertical position of ball toss
   (T = T_1 or T_3, A/V)
5. ARM = move less A/V
6. W = W_h = wrist turned horizontally, A/V, -)
   (W = W_2, A/V, hand straighter and stiffer, +)
7. RELAX
8. $G_{tighter}$, A/V
9. THINK = concentrate
   (T=3, A/V, -)
   (T=1 or 2, A/V, +)
10. CON = control
11. TIM = timing, A/V, too soon or too late
12. AGGR = aggressive
    (T=2, A/V, -)
13. E = E_3 arm lower, lower racket
14. MOC = move on the court
15. ANGLE = more angle on the court
16. C= horizontal position of the racket face
    (C = C_1, A/V, +)
17. G = shake hands with the racket
    (G = 1 or 3, A/V)
18. P = starting position
    (RELAX = trying too hard, A/V)
19. RCH = reach, -
    (E = 3, A/V, -)
    (E = 1, A/V+, arm = straight, arm = elbow straight)
    (TIM = too soon, A/V)
    (C = C_4, A/V -)
    (RCH = A/V, +, accepts previously rejected value)
20. FEELS = feels comfortable
21. RW = change rackets
22. SPIN
23. ARCH
24. S
    (S = step back, A/V)
    (G = G1 or 2?)
25. LEAN
26. F = follow through
27. BG UP = bring racket up
28. R = position of racket face
    (C = C2, A/V, -)
    (C = to left, over left shoulder, A/V, -)

APPENDIX LVII (continued)

29. MOM = momentum
    ($S = S_1$, feet together, A/V)
    (BNG DOWN, A/V)
30. MB = move body
    (MB = twist body, A/V, -)
    (MB = body straight, A/V, +)
31. COOR = coordination
32. W = wrist
    (W = W snapped, A/V, W=1)
33. WIND
34. BAL = balance
    (C = C3, A/V, -)
    (TIM = move faster, A/V, +)
    (C = C2, A/V, -)
35. G_{finger} = finger on the racket
36. B = arm back

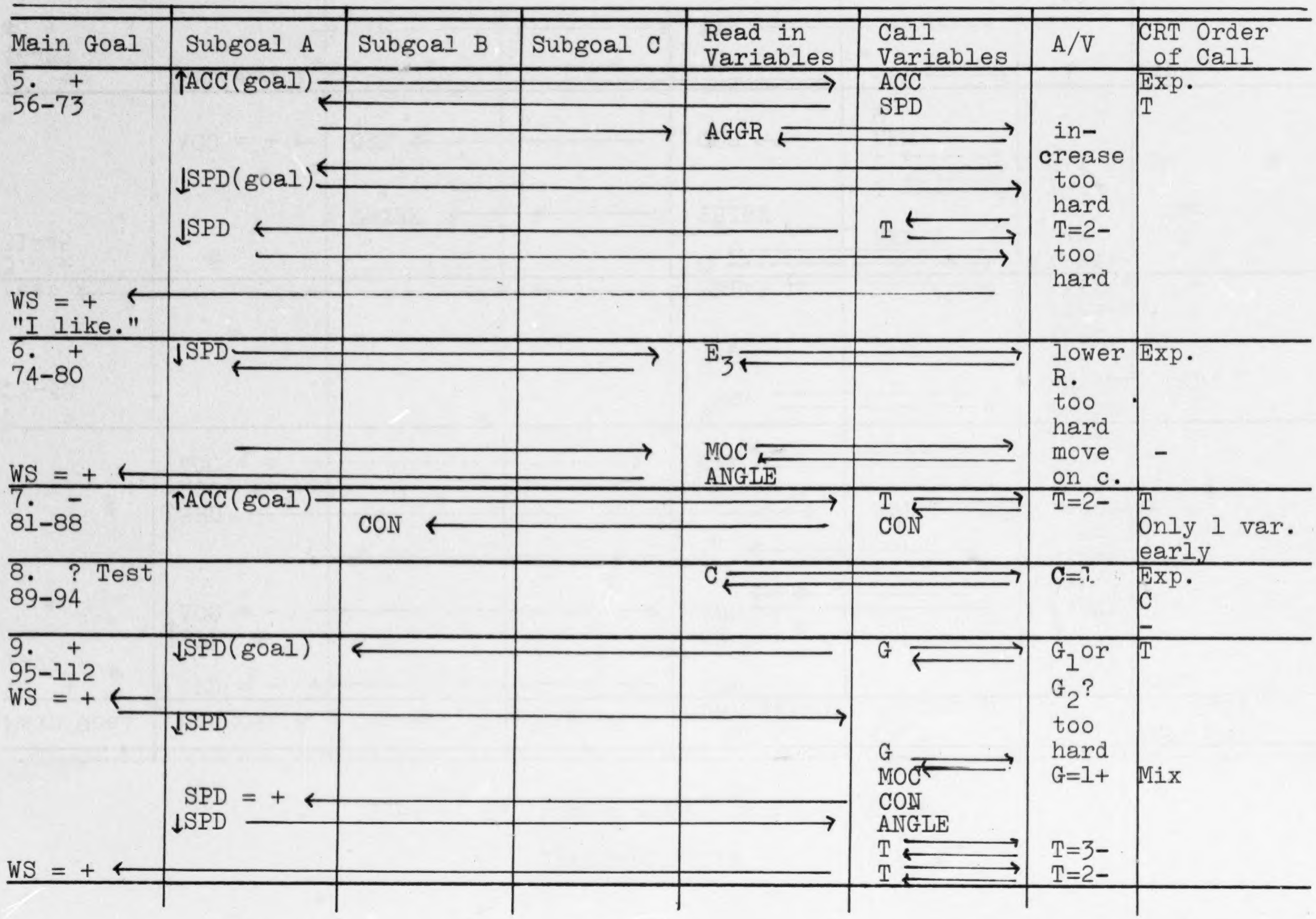
APPENDIX LVIII

Subject 5: VERBAL-MOTOR BEHAVIOR GRAPH



Main Goal	Subgoal A	Subgoal B	Subgoal C	Read in Variables	Call Variables	A/V	CRT Order of Call
1. + 1-22	SPD = -			SPD		too hard	Exp.
	↓SPD ACC = -			OC ACC		right dir.	T
				T		higher 1 or 3	
	↓SPD ↑ACC				SPD	decrease to L.	
	ACC = +			ARM		move less	
2. ? 23-30				W_{hor}		W=horizontal	Exp.
				W		W=2 turn straight	-
rest				RELAX		stiff	-
3. + 31-45				G		tighter	
					RELAX		T for
		THINK		THINK			
					T T	T=3- T=1 or 2?	
	ACC = + ←	CON		. CON	ARM W_2		
4. + 46-55 WS +	↓SPD(goal)				SPD	↓	Exp.
		→ TIM		TIM		too late	
						satisfied	-

APPENDIX LVIII (continued)



Main Goal	Subgoal A	Subgoal B	Subgoal C	Read in Variables	Call Variables	A/V	CRT Order of Call
5. + 56-73	↑ACC(goal)				ACC SPD		Exp. T
				AGGR		in-crease	
	↓SPD(goal)					too hard	
	↓SPD				T	T=2- too hard	
WS = + "I like."							
6. + 74-80	↓SPD			E_3		lower R. too hard	Exp.
				MOC ANGLE		move on c.	-
WS = +							
7. - 81-88	↑ACC(goal)	CON			T CON	T=2-	T Only 1 var. early
8. ? Test 89-94				C		C=1	Exp. C -
9. + 95-112 WS = +	↓SPD(goal)				G	G_1 or G_2?	T
	↓SPD					too hard	
					G MOC CON ANGLE	G=1+	Mix
	SPD = + ↓SPD						
WS = +					T T	T=3- T=2-	

APPENDIX LVIII (continued)

Main Goal	Subgoal A	Subgoal B	Subgoal C	Read in Variables	Call Variables	A/V	CRT Order of Call
10. - 113-120 WS=Better? ←					T ⇄ T ⇄ RELAX ⇄ →	T_1 or T_3 T=3- better before trying too hard	T -
11. -+ 121-131 WS = - ←	ACC(goal) ↓SPD →			← RCH →	← MOC T ⇄ E ⇄ E ⇄	too hard T=2 E=3- E=1+ "can't do"	T Rev
12. + 132-142 WS = + ←					E_1 MOC E_1 ⇄	"better"	Rev
13. + 143-149 WS = + ←		TIM → FEELS ←		FEELS ⇄	TIM ⇄ TIM ⇄ G ⇄ C ⇄	too late too soon tight- er C=4- Comf. "better"	C - Rev
14. ? ← 150-152 → RS = ?	SPD = - ⇄ ACC = + ⇄	FEEL →		CR		- Comf. too hard	-

APPENDIX LVIII (continued)

Main Goal	Subgoal A	Subgoal B	Subgoal C	Read in Variables	Call Variables	A/V	CRT Order of Call
15. +					RCH		C
153-155					E_3 ⇄	bent	
						elbow	
					G ⇄	tighter	
					E_1 ⇄	elbow	
						st.	Rev.
					C	by	
	ACC = + ←	—	—	—	MOC ⇄	corner	
16. -					E_3		-
156-162	↓SPD ←	—	—	—	RELAX ⇄	trying	
						too	
						hard	For
17. ?				←	RELAX		T
Test	↑SPD ←	SPIN ←	↑SPIN= ↑SPD	← SPIN			
163-165	—	→					
	↑ACC ←	—	↑SPD=				
	—	→	↑SPIN=	→	G ⇄	G=2	Rev
			↓ACC		T		
					W_2		
18. ?		SPIN ←	—	—	SPIN		T
166-168					G ⇄	G=2	
					MOC		
					T ⇄	T=1	
						or 3	
		—	—	→	G ⇄	tighter	Rev
	ACC = - ←	—	—	—	G ⇄	G=2	
19. -	ACC = - —	—	—	→	T ⇄	disgust	T,C
169-172				ARCH ←	RCH		
				S_{back} →	C ⇄	S=back C=1	Rev
	ACC = - ←	FEELS ←	—	—		good	

APPENDIX LVIII (continued)

Main Goal	Subgoal A	Subgoal B	Subgoal C	Read in Variables	Call Variables	A/V	CRT Order of Call
20. ? 173-184	ACC = - ←			←	E_3		T
	→			→	MOC		
					G_2 ⇄	G=2	For
		←		←	G_1 ⇄	G=1 more comf.	
		FEELS →	G_1=Comf.↑ (A/E)	→	SPIN		
	ACC = + ←	←	G_1=as much spin?	←			
	→	→		Lean → ⇄ →	T ⇄	T?	
					G ⇄	Gl or	2?
					RCH ⇄	in- crease	
21. + 185-195				←	G_1		T,R,C
				F BNG UP →	E_3		Rev
					T ⇄	T_1 or $_3$?	
				R ←	E_1		
				→	C ⇄	C=2-	
WS = "pretty well"	ACC = + ←				G ⇄	tighter	
22. + 196-198	ACC = + → ←			→	C		C
	→				→	left	-
23. +- 199-211					C ⇄	C=4-	C
		←		←	RCH		
WS = satisfied ←		FEEL →			→	good	only 1 recent
24. +- 212-221	→			→	G ⇄	tight- er	-
	ACC = - ←			←	ANGLE		
	SPD						
	SPD = - →	TIM			TIM ⇄	wait too long	Rev

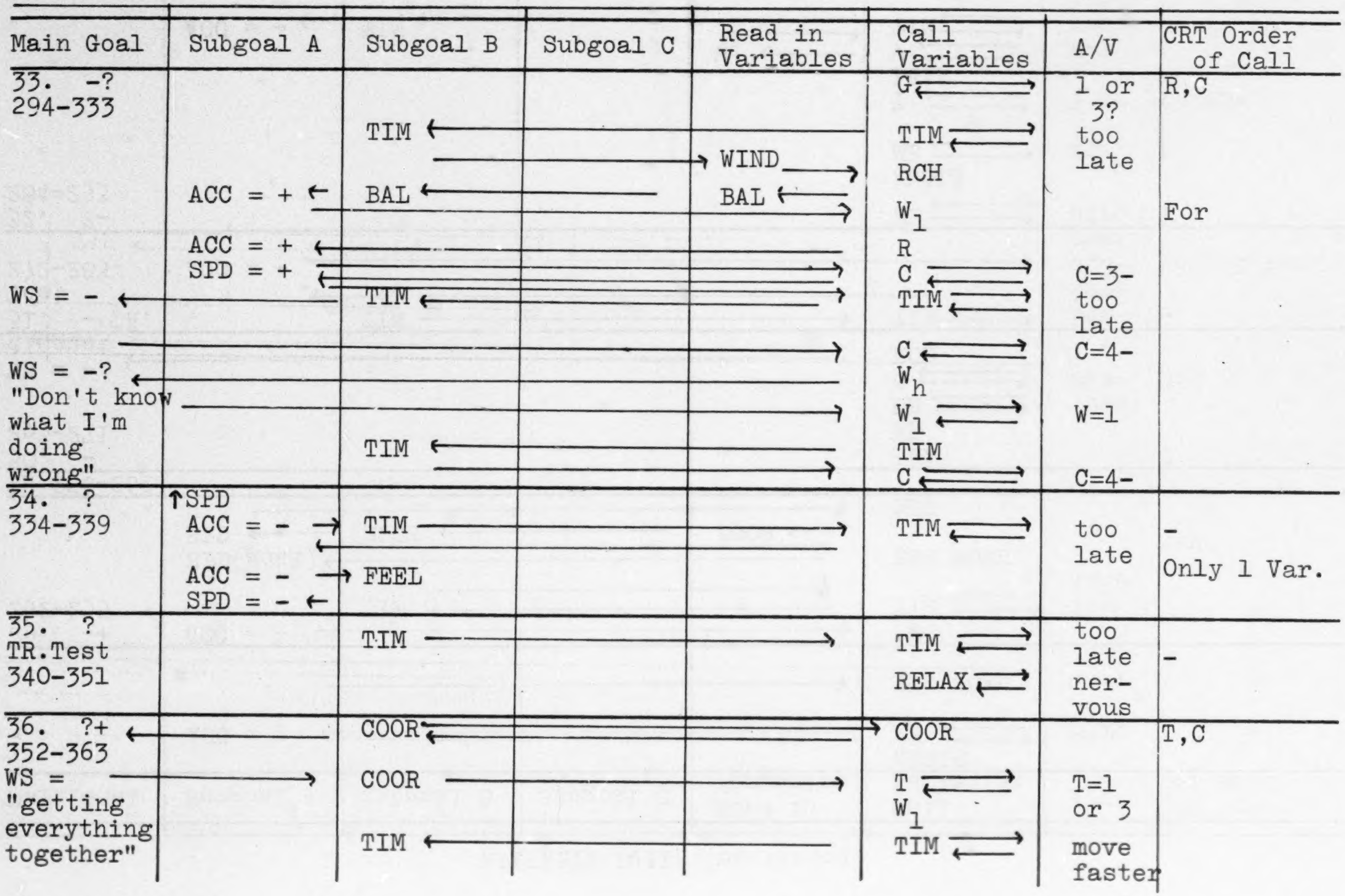
APPENDIX LVIII (continued)

Main Goal	Subgoal A	Subgoal B	Subgoal C	Read in Variables	Call Variables	A/V	CRT Order of Call
25. +					T		T,C
222a					C		
					E_1		Rev
					LEAN		
					ARCH		
					RCH		
26. ?					E_1		T,C or C,T
222b - 231				MOM ⇄	LEAN		
					T		
					C		Mix
					E_1		
looks at pictures				S_1 ⇄	ANGLE		
					T		
					C		
					C ⇄	C=3?	
					RCH		
					T ⇄	3 or 1?	
27. ?	ACC = - →	CON →		→	G ⇄	1 or 2?	
232-239					CON		-
				BNG DOWN ←	G ⇄	1 or 2?	Mix
				→	W_{hor}		
		SPIN ←			SPIN		
					BNG DOWN		
		SPIN = - →		→	SPIN ⇄	not much right dir.	
	↑ACC ←						
28. +				MB →	→	move	-
240-251					ANGLE ←	body	
					MB ⇄	twist	
					MB		for

APPENDIX LVIII (continued)

Main Goal	Subgoal A	Subgoal B	Subgoal C	Read in Variables	Call Variables	A/V	CRT Order of Call
	ACC = + ←				ANGLE MB ⇄	Str.	
	→				BNG DOWN	Str.	
29. -+ 252-255	ACC = - →	TIM ← →			ACC TIM ⇄	too late	
	SPD(goal) ← SPD ←	COOR ←		COOR ←	BNG DOWN		– Rev
	→				MOC		
TR 256-262							
30. - 263-271					LEAN MB MB ⇄ C ⇄ RCH	 twist C=4-	C Mix
WS = - ← disgust							
31. - TR. Test 272-283	← ACC = - →	TIM →			TIM ⇄	too late dis-gust	– Only 1 var.
32. ?- 284-293					MB ⇄	str.	T
					ANGLE MB ⇄	str.	
					T ⇄	1 or 3?	Mix
	ACC = - ←	TIM ←		W_1 ⇄	LEAN W ⇄ TIM ⇄	W=1 too late	

APPENDIX LVIII (continued)



Main Goal	Subgoal A	Subgoal B	Subgoal C	Read in Variables	Call Variables	A/V	CRT Order of Call
33. -? 294-333					G ⇄	1 or 3?	R,C
		TIM ←			TIM ⇄	too late	
		→		WIND →	RCH		
	ACC = + ←	BAL ←		BAL ←			
	→			→	W_1		For
	ACC = + ←				R		
	SPD = +			→	C ⇄	C=3-	
WS = - ←		TIM ←		→	TIM ⇄	too late	
→				→	C ⇄	C=4-	
WS = -? ←					W_h		
"Don't know what I'm doing wrong" →				→	W_1 ⇄	W=1	
		TIM ←			TIM		
		→		→	C ⇄	C=4-	
34. ? 334-339	↑SPD ACC = - →	TIM →		→	TIM ⇄	too late	-
	←						
	ACC = - →	FEEL					Only 1 Var.
	SPD = - ←						
35. ? TR.Test 340-351		TIM →		→	TIM ⇄	too late	-
					RELAX ⇄	nervous	
36. ?+ 352-363 ←		COOR ⇄		→	COOR		T,C
WS = →		COOR →		→	T ⇄	T=1 or 3	
"getting everything together"					W_1		
		TIM ←			TIM ⇄	move faster	

APPENDIX LVIII (continued)

Main Goal	Subgoal A	Subgoal B	Subgoal C	Read in Variables	Call Variables	A/V	CRT Order of Call
	ACC = + ←				C ⇄ T ⇄	C=2- T=1 or 3	Rev
	→				C_2		
	ACC = + ←						
37. ? 364-381	ACC = - ←				C_2		C
	→				W_1		
	←				MB ⇄	twist	
	ACC = - →				MB ⇄	str.	
	←						
	↑ACC(goal) →			G_{finger}	→ ←	finger on racket	Only 1 var. recent
	SPD = - ←				C_2		
WS = ?	→				C_2		
38. ? 382-413	↑SPD(goal) ←				W_1		C,T
	→				RCH		
					C_2		Mix
		TIM ⇄			TIM ⇄	too soon	
←					T		
WS = ? →		→	B + MOM →		MOM		
39. +TR 414-419		FEEL ⇄			B(goal) →	bet- ter	-
					RELAX ←	ner- vous	Rev
TR. Test 420-430							

APPENDIX LVIII (continued)

Main Goal	Subgoal A	Subgoal B	Subgoal C	Read in Variables	Call Variables	A/V	CRT Order of Call
TR. 431-461							
40. ? 462-464 ←	↑SPD ←	—	—	—	B		– Only 1 Var. recent
TR.Test 465-474							

APPENDIX LIX

Subject 5: SYNOPSIS OF VERBAL-MOTOR BEHAVIOR GRAPH

-	- +	?		+	+ -
CRT	Order of Call	CRT	Order of Call	CRT	Order of Call
7. T	Only 1 Var.	2. -	-	1. T	-
10. T	--	8. C	-	3. T	For
11. T	Rev	14. -	-	4. -	-
16. -	For	17. T	Rev	5. T	Only 1
19. T,C	Rev	18. T	Rev	6. -	-
29. -	Rev	20. T	For	9. T	Mix
30. C	Mix	21. T,C, C,T	Mix	12. -	Rev
31. -	Only 1 var.			13. C	Rev
33. R,C	For/Back	27. -	Mix	15. C	Rev
		32. T	Mix	21, T,R, C	Rev
		34. -	Only 1 Var.	22. C	-
		35. -	-	23. C	Only 1 recent
		37. C	Only 1 Var.	24. -	Rev
		38, C,T	Mix	25. T,C	Rev
		40. -	Only 1 Var. R	28. -	For
				36. T,C	Rev
				39. -	Rev
TOTALS T = 3 C = 1 TC = 1 RC = 1	Mix = 1 For = 2 Rev = 3	T = 4 C = 2 CT = 2 or TC =	Mix = 4 For = 1 Rev = 2	T = 4 C = 4 TC = 2 TRC = 1	Mix = 1 For = 2 Rev = 8

APPENDIX LX

Subject 5: ANALYSIS OF VERBAL PROBLEMS BY MOTOR PLOT SCORES*

Problem	Episodes	#Episodes	Sol. Code	Range of Scores	Motor Plot Total Score	Initial Score	Final Score	Mean Score
1	1-22	22	3	16-27	440	17	19	20.00
2	23-30	8	1	21-27	187	25	21	23.37
3	31-45	15	3	17-33	370	19	23	24.66
4	46-55	10	3	12-23	196	21	20	19.60
5	56-73	18	3	14-29	377	17	29	20.94
6	74-80	7	3	20-33	188	29	20	26.85
7	81-88	8	2	15-26	163	18	26	20.37
8	89-94	6	1,7	23-27	152	23	27	25.33
9	95-112	18	3	17-37	500	31	31	27.77
10	113-120	8	2	23-51	267	34	28	33.37
11	121-131	11	4	24-34	304	28	29	27.63
12	132-142	11	3	21-40	352	40	33	32.00
13	143-149	7	3	28-35	209	33	28	29.85
14	150-152	3	1	21-24	68	21	24	22.66
15	153-155	3	3	24-33	87	30	24	29.00
16	156-162	7	2,7	21-37	221	35	35	31.57
17	163-165	3	1,7	15-34	79	15	34	26.33
18	166-168	3	1	31-35	101	35	35	33.66
19	169-172	4	4	30-52	171	51	38	42.75
20	173-184	12	1	24-37	353	37	24	29.41
21	185-195	11	3	27-48	407	36	48	37.00
22	196-198	3	3	29-41	103	29	33	34.33
23	199-211	13	3,6	26-45	455	33	42	35.00
24	212-221	11	5	32-48	377	35	33	34.27
25	222	1	3,7	-----	40	--	--	40.00
26	223-231	9	1	18-37	264	34	23	29.33
27	232-239	8	1	24-36	236	36	30	29.50
28	240-251	12	3	29-58	467	48	36	38.91
29	252-255	4	4	37-51	165	40	37	41.25

APPENDIX LX (continued) *

Problem	Episodes	#Episodes	Sol. Code	Range of Scores	Motor Plot Total Score	Initial Score	Final Score	Mean Score
TR	256-262	7	6	35-48	279	37	48	39.85
30	263-271	9	2	30-48	340	48	30	37.77
31	272-283	12	2,6	27-50	448	27	36	37.33
32	284-293	10	1	25-49	325	37	25	27.08
33	294-333	40	2	24-49	1468	32	27	36.70
34	334-339	6	1	27-45	215	31	27	35.83
35	340-351	12	2,7	25-42	414	35	41	34.50
36	353-363	12	3	24-33	337	27	33	28.08
37	364-381	18	1	21-39	559	22	34	31.05
38	382-413	32	1	20-42	1008	36	34	31.50
39	414-419	6	3,6	32-44	237	32	44	39.50
TR	420-430	11	7	35-56	478	40	47	43.45
TR	431-461	30	6	27-47	1059	33	29	35.30
40	462-464	3	1	37-49	126	40	49	42.00
TR	465-474	9	6,7	29-43	349	43	34	38.77

* The legend for abbreviations and symbols is found in Appendix VI.

APPENDIX LXI

Subject 5: ANALYSIS OF HIGHEST SCORES DURING EACH PROBLEM

Problem	Episode	Score	Analysis of Verbal Data Around Highest Score	Result
1	7	27	↓SPD	-+, 1 Prop.
2	24,25	27	W_{hor}	+, 1 Prop
3	32,43	33	NC, T_2 =↑ACC; T_3 =↓ACC	+, A/V, A/E
4	47,48	23	↓SPD	- +
5	61,73	29	"I like this serve"	+
6	77	33	T=2-	-, 1 Prop.
7	88	26	T_2 + CONT	-, Comb. Props.
8	92-94	27	C_5 or C_1, TESTING C	TE, A/V
9	97	37	NC. G + SPD, G=1 (95)	A/V, Comb.
10	115	51	T=T_3	A/V,?
11	129	34	↓RCH + E_2 = -	A/V,A/E, -
12	132	40	NC, E_1 = goal (133)	+, T
13	145	35	G + C_3 = -	Comb. Props -, C_3
14	152	24	FEEL + SPD = -	ACC/ SPD goals,-
15	154	33	RCH	Test 1 Var.
16	157	37	E_2	Test 1 Var.
17	165	34	RELAX + E_1 + SPIN + G + T + HD straight	-, Comb. props.
18	167,8	35	ACC	+,ACC goals
19	170	52	NC, ACC	Test ACC
20	173	37	E_2	Test 1 Var.
21	192,5	48	T + C_5 + G + E	-, + Comb. Props.
22	197	41	T	Test 1 Var.
23	205	45	NC RCH + C	Comb. Props. & Elems.

APPENDIX LXI (continued)

Prob-lem	Episode	Score	Analysis of Verbal Data Around Highest Score	Result
24	215	48	ANGLE =↓SPD	-, A/E, Comb.
25	222	40	"I was satisfied..."	+
26	226,9	37	NC, ANGLE	Test 1 Var.
27	232	36	NC, ACC = T+C+G+CONT (231,3)	A/E, Comb.
28	242	58	NC, ACC = ANGLE + SPIN + HD(239)	A/E, Comb.
29	253	51	NC, HD straight (251)	Test 1 Var.
TR	262	48	NC, COOR (255)	TR, Comb. into larger elem.
30	263,5	48	LEAN + BODY (st.)	+, A/V, Comb.2 new props.
31	276	50	NC.	Test
32	285	49	NC. BODY (st.) = ANGLE + T_3 + LEAN (for.)	Comb. values/ Props.
33	298,317	49	G	Test G, A/V
34	335	45	NC. ACC = TIM	-, A/E, Comb. into elems.
35	349	42	NC, TIM + NERVOUS	Test, Comb. into elems.
36	scat-tered	33	NC., NC, C + T, plateau	A/V, Test Comb.
37	371	39	G_{finger}	Test 1 Var.
38	396	42	NC,↑SPD (394)	Test
39	Scat-tered	44	NC, NERVOUS, B =↑SPD	Test, Comb. A/E, 1 Var.
TR	423	56	NC,	
TR	450	47	NC,	
40	464	49	B =↑SPD	A/E, Test
TR	465-70	43	NC,	Test

APPENDIX LXII

Subject 5: INCREASES AND DECREASES IN MOTOR PERFORMANCE SCORES WITHIN AND BETWEEN DAYS

Days	Increases	Decreases	Scores Remaining the Same	Total
Between	2 (33.33%)	4 (66.66%)	0 (00.00%)	6
Within	16 (43.24%)	15 (40.54%)	6 (16.21%)	37
Total	18 (41.86%)	19 (44.19%)	6 (13.95%)	43

APPENDIX LXIII

Subject 5: THE EFFECTS OF REST UPON THE WITHIN DAY INCREASES AND DECREASES OF MOTOR PERFORMANCE SCORES

Increase With Rest	Increase Without Rest	Decrease With Rest	Decrease Without Rest	Stays Same With Rest	Stays Same Without Rest	Total
2 (5.40%)	14 (37.83%)	1 (2.70%)	14 (37.83%)	1 (2.70%)	5 (13.51%)	37
Total	16 (43.24%)		15 (40.54%)		6 (16.21%)	37

APPENDIX LXIV

Subject 5: ANALYSIS OF VERBAL PROBLEMS BY ACCURACY/SPEED SCORES

Problem	#Episodes	Raw Score Accuracy	Raw Score Speed	Accuracy Ratio (6 max)	Speed Ratio (4 max)	Sol.Code[a]
1	22	16	10	.72	.45	3
2	8	10	7	1.25	.87	1
3	15	25	11	1.66	.73	3
4	10	8	7	.80	.70	3
5	18	15	12	.83	.66	3
6	7	5	4	.71	.57	3
7	8	7	5	.87	.62	2
8	6	4	4	.66	.66	1,7
9	18	14	8	.77	.44	3
10	8	2	2	.25	.25	2
11	11	1	1	.09	.09	2
12	11	11	7	1.00	.63	3
13	7	2	1	.28	.14	3
14	3	5	2	1.66	.66	1
15	3	2	2	.66	.66	3
16	7	4	2	.57	.28	2
17	3	3	3	1.00	1.00	1,7
18	3	0	0	.00	.00	1
19	4	0	0	.00	.00	4
20	12	0	0	.00	.00	1
21	11	1	1	.09	.09	3
22	3	1	1	.33	.33	3
23	13	10	6	.76	.46	3,6
24	11	5	6	.45	.54	5
25	1	2	2	2.00	2.00	3,7
26	9	5	3	.55	.33	1
27	8	0	0	.00	.00	1
28	12	0	0	.00	.00	3
29	4	2	2	.50	.50	4
TR	7	0	0	.00	.00	6
30	9	5	5	.55	.55	2
31	12	3	2	.25	.16	2,6
32	10	4	4	.40	.40	1
33	40	23	12	.57	.30	2
34	6	1	1	.16	.16	1
35	12	2	2	.16	.16	2,7
36	12	2	2	.16	.16	3
37	18	11	9	.61	.50	1
38	32	15	8	.45	.25	1
39	6	1	1	.16	.16	3,6
TR	11	5	5	.45	.45	7
TR	30	19	15	.63	.50	6
40	3	4	4	1.33	1.33	1
TR	9	11	7	1.22	.77	6,7

[a] See Appendix VI for the key to the figures.

APPENDIX LXV

Subject 5: INCREASES AND DECREASES IN ACCURACY AND SPEED SCORES WITHIN AND BETWEEN DAYS

ACCURACY

Days	Increases	Decreases	Scores Remaining the Same	Total
Between	0 (00.00%)	1 (16.66%)	5 (83.33%)	6
Within	13 (35.13%)	8 (21.62%)	16 (43.24%)	37
Total	13 (30.23%)	9 (20.93%)	21 (48.83%)	43

SPEED

Days	Increases	Decreases	Scores Remaining the Same	Total
Between	0 (00.00%)	1 (16.66%)	5 (83.33%)	6
Within	9 (24.32%)	7 (18.91%)	21 (56.75%)	37
Total	9 (20.93%)	8 (18.60%)	26 (60.46%)	43

APPENDIX LXVI

Subject 5: THE EFFECTS OF REST UPON THE WITHIN-DAY INCREASES AND DECREASES OF ACCURACY AND SPEED SCORES

ACCURACY

Increase With Rest	Increase Without Rest	Decrease With Rest	Decrease Without Rest	Stays Same With Rest	Stays Same Without Rest	Total
2 (5.40%)	11 (29.72%)	1 (2.70%)	7 (18.91%)	1 (2.70%)	15 (40.54%)	37
Total	13 (35.12%)		8 (21.62%)		16 (43.24%)	37

SPEED

Increase With Rest	Increase Without Rest	Decrease With Rest	Decrease Without Rest	Stays Same With Rest	Stays Same Without Rest	Total
2 (5.40%)	7 (18.91%)	1 (2.70%)	6 (16.21%)	1 (2.70%)	20 (54.05%)	37
Total	9 (24.32%)		7 (18.91%)		21 (56.75%)	37

APPENDIX LXVII

Subject 6: HEWITT SERVE TEST SCORE ANALYSIS

Day	EPS	Raw Accuracy Score	Raw Speed Score	T-Score Accuracy	T-Score Speed
1	60-69	4	4	53	53
2	174-183	12	10	69	69
3	268-277	13	10	70	69
4	367-376	3	5	49	58
5	488-497	19	12	80+	75
6	557-566	5	5	55	58

APPENDIX LXVIII

Subject 6: ACCURACY-SPEED MEAN DAILY SCORES

Day	#of Serves	Raw Accuracy Scores	Raw Speed Scores	Mean Accuracy	Mean Speed
1	67	45	29	.67	.43
2	104	90	68	.86	.65
3	94	96	85	1.02	.90
4	99	84	63	.84	.63
5	121	123	105	1.01	.86
6	67	50	36	.75	.54
Total	552	488	386	5.15	4.01

Average daily accuracy = .86
Average daily speed = .67

APPENDIX LXIX

ORDER SUBJECT 6 READS IN VARIABLES, PROPERTIES AND ELEMENTS

1. FEEL
2. G = grip steady, A/V
3. R = racket straight, A/V
4. W = W_3, A/V
5. HD = hit down, come down lower
6. T = vertical position of ball toss
   (T = T_3 or T_1, higher, A/V, +)
7. ACC = accuracy
8. SPD = speed
9. F = follow through
10. OC = on center, solid hit
11. S = stance
    (S = S_9 - foot action, A/V)
    (ACC = lower over the net, A/V, +)
    (T = lower, T=2)
12. B = backswing, more throwing action, winding action
    (R = R3, A/V, +)
    (R = R1, square, A/V, +)
13. MOC = move on the court, change court position
14. S_{14} = bent knees
15. EYES = eyes on the ball
16. BAL = balance
17. C = horizontal position of ball toss
    (C = C_4, A/V, -)
    (T = T_1 or T_3, AV)
    (C - C_3, A/V, -)
18. RCH = reach
19. FS = forward swing
    (C = C_1, A/V, further from the body, +)
    (R = hit up R_2, A/V)
20. TIM = timing
    (TIM = wait, A/V, +)
    (BLISTER)
21. ARCH = bend
22. P = forward positioning, facing the net
    (P = 3 facing the net more, A/V, +)
23. E = bent elbow
    (E = E_2 - E_4, A/V)
    (E = E_1 elbow straight, A/V)
24. BNG UP = bring the racket up
25. HIT UP, A/V, +
    (P = P_1, A/V, +)

APPENDIX LXIX (continued)

(R = to left, A/V, -)
(S = step back, A/V, -)

26. SLICE
27. WIND -
    (SLICE = -)
28. LEVER
    (Lever = shorter forearm, A/V)
    (Lever = longer forearm, A/V)
    ($G=G_2$?)
29. TOP
    (S = left leg stationary)
    (TIRED/SORE)
30. LEAN
    (Lean = to L, A/V)

APPENDIX LXX

Subject 6: VERBAL-MOTOR BEHAVIOR GRAPH

Main Goal	Subgoal A	Subgoal B	Subgoal C	Read in Variables	Call Variables	A/V	CRT Order of Call
1. -		FEEL →	→	FEEL ⇄	⇄	get	R,T
1-9				G ⇄	⇄	steady	
			$R_1 + W_3$ ←	R_1 ⇄	⇄	R=1	
			→	W_3 ⇄	⇄	W=3	
				HD			
		←	←	T ⇄	⇄	T_1 or 3	Rev
	ACC = + →	→	→	ACC			
	SPD = - ←	←	←	SPD			
	↓SPD(goal) →	→	→	→	SPD ⇄	de-crease	
	↑ACC ←	←	←	←	ACC		
	↓SPD →	→	→	→	SPD		
					HD		
					T ⇄	too high	
2. -+	↓SPD ←	←	←	←	T ⇄	T_3?	T
10-13	→	→	→	F ⇄	⇄	de-crease	
			↓SPD=↓F ←	←			-
3. ?	SPD = + ←	←	←	OC ⇄	⇄	solid hit +	
14-17	ACC = - →	→	→	S_9 ⇄	⇄	foot action	
4. -+	ACC = + →	→	→	→	ACC ⇄	more to R	T
18-33					OC		
					F		
	ACC = + ←	←	TESTING T ←	←	T ⇄	higher=3	Rev
	ACC(goal) →	→	→	→	T ⇄	lower=2	

APPENDIX LXXX (continued)

Main Goal	Subgoal A	Subgoal B	Subgoal C	Read in Variables	Call Variables	A/V	CRT Order of Call
5. −+ 34-50					T ⇄	lower	T,R
					F		
			TESTING T ←	→ B ⇄	T ⇄	T=1or 3? throwing action	Rev
	←						
	↑ACC ←			→	R ⇄ ACC	R=3	
					T ⇄	lower=2	
					R ⇄	R=1 square	
	↑ACC ←				T ⇄	lower=2 move	
	→			MOC			
6. + 51-58					MOC		R
				←	R ⇄	square=1 bend knees	
				S_{14} →			
	ACC ←		R=Square + Aim ←		R ⇄	square	Rev
	→				W_3		
7. −+ Test 59-69	ACC →				T		T,C
	ACC = − ←			EYE ←			
	→ BAL →			BAL →	T		
					ACC ⇄	Lower over net	
				C ⇄		C=4−	For
				→	BAL		
	↑ACC(goal) ←				T_2 ⇄	lower	
8. +− 70-78					B		T
					T ⇄	T=2 lower	
					MOC		
					B		
	↓SPD ←	FEEL ←	FEEL=ACC+ SPD+Court position	←	FEEL		

APPENDIX LXX (continued)

Main Goal	Subgoal A	Subgoal B	Subgoal C	Read in Variables	Call Variables	A/V	CRT Order of Call
					T ⇄	T=2lower	
	↑ACC ⟶	FEEL ⟶	⟶	⟶	FEEL ⇆	better	For
				W ⇄	⟶	↑wrist	
					⟵	action	
			T + B ⟵	⟵	T		
			⟶	⟶	B		
9. +			TESTING T	⟵	T ⇄	T=1,2,3	T,C
79-88			→	RCH ⟶	C ⇄	C=3	
	ACC ⟵	BAL ⟵	⟵	⟵	BAL		
	⟶	FEEL ⟶	⟶	⟶	⇄	good	
					T ⇄	T=3-	Rev
					B ⇄	more	
						windup	
10. +					B(goal)		T
89-93		FEEL ⇄	⇄	⇄	RCH ⇄	better	
					RCH ⇄	increase	
					T		
					B ⇄	B=1 more	For
11. +				⇄	B(goal)		T,R
94-104				FS ⟶	T ⇄	higher	
		⟵	⟵	⟵	F		
		FEEL ⟶	⟶	⟶	⇄	better	Rev
					R ⇄	R=1 square	
12. −+					R(goal)		R,T,C
105-111					RCH		
					T ⇄	T=21 over	
	↑ACC ⟵	⟵	⟵	⟵	ACC		
	↓SPD ⟶	FEEL ⟶	↓SPD=ACC↑ ⟶	⟶	ACC ⇄	lower	
						over net	
						better	
					S_{14} ⇄	bends	
						knees	Rev

APPENDIX LXX (continued)

Main Goal	Subgoal A	Subgoal B	Subgoal C	Read in Variables	Call Variables	A/V	CRT Order of Call
					T ⇄	T=2 lower	
					C ⇄	C=1 or 5?	
13. + 112-123					R_2 ⇄	hit up	R,T
					R_1 ⇄	square	
	↓SPD ←				T ⇄	T=3-	
	ACC = + →				T ⇄	T=1 higher	Rev
					OC		
					W ⇄	firm	
14. ? 124-133	ACC →				ACC ⇄	lower over net	T
		←			T ⇄	T=2	
		TIM →		TIM →		wait	
					HD		Only 1 Var. early
15. + 134-143					T ⇄	T=3 higher	T
					T ⇄	T=2 lower	
		FEELS ←			RCH ⇄	better	
		→	B = RCH → (A/E)		B		
							Rev
		FEELS ⇇			→	better	
16. -+ 144-173					RCH(goal)		T
					T ⇄	T=3-	
	↑ACC ←	TIM ←	ACC=WAIT ← (A/E)		TIM ⇄	wait	
	→				T ⇄	T=3 higher	
					TIM ⇄	wait	
					RCH ⇄	lower	
					T ⇄	T= -	
	↑ACC ←				T		
	→	TIM →			TIM ⇄	wait too long	

APPENDIX LXX (continued)

Main Goal	Subgoal A	Subgoal B	Subgoal C	Read in Variables	Call Variables	A/V	CRT Order of Call
	←	←	←	←	T ⇄	T=3-	
	ACC = - →	→	→	→	RCH		
					T		
			T + B ←	←	B		For/ back-
			→	→	T		track
		TIM ←	←	(blister)←	TIM		
		→	→	→	RCH		
					T		
	↑ACC ←	←	RCH = T + B ←	←	B		
			= ACC (A/E)		ACC ⇄	lower	
	↑SPD →	→	→	→		over net	
17. ?					B		T,R,C
Test			B+T higher	⇄	T ⇄	higher	
174-183					R		
					HD		
					C ⇄	C=1	
					T ⇄	higher	Rev
		FEELS ←	←	←	←	better	
18. +			←	←	RCH		T,C
184-187			RCH+B+T →	→	B		
					T		
			TEST C ⇄	⇄	C(goal) ⇄	Cl or 4?	
					T		Rev
					RCH		
	↑ACC ←	TIM ←	←	←	TIM ⇄	wait	
19. -+		←	TEST T ←	←	T(goal)		T,R
188-202		TIM →	→	→		wait	
					R ⇄	R=1 square	
					T ⇄	higher	Mix
		TIM ←	←	←	TIM ⇄	wait	
		→	→	→	RCH		
					HD		
					B		

APPENDIX LXX (continued)

Main Goal	Subgoal A	Subgoal B	Subgoal C	Read in Variables	Call Variables	A/V	CRT Order of Call
	←	——	——	——	T ⇄	higher	
					EYE		
	↑ACC ↑SPD						
20. ? 203-217					T ⇄	higher	T
					OC		
	↑SPD ←	——	——	——	SPD		
	→	TIM ——	——	——→	TIM ⇄	wait	
					T ⇄	T=2-	
	↑SPD/ACC ← (goal)	——	——	——	RCH		For
21. -+ 217-225					MOC		T
	ACC = - ←	——	——	——	B		
	↑SPD ——	——	——	——→	B		
					T		For
		BAL ←	ACC/SPD= ←	——	BAL ⇄	BAL=-	
		TIM →	BAL+TIM+ court pos.	——→	TIM ⇄	wait	
22. -+ 226-238		BAL ——	——	——→	BAL		T,C
					RCH		
					T ⇄	higher	
					C ⇄	C=4-	
	↑ACC ←	TIM ←	——	——	TIM ⇄	wait	For
23. +- 239-263					C ⇄	C=4-	C,T,R
					C ⇄	C=1+	
	SPD ←	——	——	——	T ⇄	T1 or T3	
	——	TIM ——	——	——→	TIM ⇄	wait	Rev/Backtrack
				ARCH ←	R ⇄	R=1 square	
				→	HD ⇄	bend	
					RCH		
					T ⇄	lower	
				←	HD		

APPENDIX LXX (continued)

Main Goal	Subgoal A	Subgoal B	Subgoal C	Read in Variables	Call Variables	A/V	CRT Order of Call
				←	HD		
				P ⇄	⇄	forward	
						P=3 facing	
						net more	
				→	C ⇄	C=5-	
					T ⇄	T=2-	
		TIM ⇄	⇄	⇄	TIM ⇄	wait	
					RCH		
					T		
					HD		
	ACC = + ←	←	←	←	ACC ⇄	aim lower	
						over net	
TR 263-269							
24. -+					C ⇄	C_1+	C,R,T
270-277					C ⇄	C_5-	
		TIM ⇄	⇄	⇄	TIM ⇄	wait	
					R ⇄	R=1 sq.	
	ACC ⇄	⇄	⇄	⇄	HD		
		TIM ⇄	⇄	⇄	TIM		
					T ⇄	T=1	Mix
				←	HD		
				E ⇄	⇄	elbow	
						bent	
						E_2-E_4	
					T ⇄	higher	
					MOC ⇄	center	
						court	
25. +	↑SPD ←	←	←	BNG UP ⇄	E_1 ⇄	elbow st.	T,C,R
278-325				→	T ⇄	T_1 or T_3	
					T ⇄	T_2	

APPENDIX LXX (continued)

Main Goal	Subgoal A	Subgoal B	Subgoal C	Read in Variables	Call Variables	A/V	CRT Order of Call
					HD		
					T ⇄	higher	
					C ⇄	C=4-	
					C ⇄	C=5	
					MOC		Rev/backtrack
					C ⇄	C=1	
					C ⇄	C=4	
					T ⇄	T=2	
		TIM ⇄			TIM ⇄	wait	
					HD(goal)		
					E_1		
	↑SPD ⇄			HIT UP —	HD ⇄	New Value	
					P ⇄	P=1	
					T ⇄	too	
					HD	high 3-	
	↑ACC ⇄				RCH		
					R ⇄	R=1 sq.	
	↑ACC ⇄				HD		
					T ⇄	higher	
					RCH		
					C ⇄	C=4-	
		TIM ⇄			TIM ⇄	wait	
					R ⇄	to left	
					R ⇄	R=1 sq.	
					HD ⇄	+	
					RCH		
					HD ⇄	+	
26. ?	↓SPD ⟶				T ⇄	higher	T,C
326-343		FEEL ⟵			FEEL ⇄	good	
					E_1		
					T ⇄	higher	

APPENDIX LXX (continued)

Main Goal	Subgoal A	Subgoal B	Subgoal C	Read in Variables	Call Variables	A/V	CRT Order of Call
					RCH ⇄	-	
			TEST C ←		C ⇄	C=1 or 5?	Rev
			→	$S_{\text{step b}}$ ←	⇄	S=step back	
	↑SPD ←				HD		
	↑ACC ⇄				EYES		
27. ? 344-365	ACC(goal) →				HD		T,R
					RCH		
					B		
					T ⇄	higher	Mix
		FEEL ←			FEEL ⇄	Better	
					RCH		
		TIM →			TIM		
		BAL ⇄			BAL		
					R ⇄	R=1 sq.	
				SLICE ←	HD		
	←			WIND			
	ACC = - →				HD		
	ACC = - ←				T ⇄	higher to L.	
28. + 366-369					SLICE ⇄	stop -	
					HIT UP ⇄	-	-
					HD ⇄	+	Rev
		FEEL ←			FEEL ⇄	better	
29. ? 370-376a					WIND		T
					BNG UP		
					T ⇄	T=2	
				←	T ⇄	T=3	
				LEVER ⇄		shorter,	
				→	LEVER ⇄	longer	Mix
					G ⇄	G=2?	
					SLICE		
					WIND		

APPENDIX LXX (continued)

Main Goal	Subgoal A	Subgoal B	Subgoal C	Read in Variables	Call Variables	A/V	CRT Order of Call
30. + 376b-413					G(goal) ⇄	G=2-	
					G ⇄	G=1?	
	↑ACC ←				MOC ⇄	to R	R,T,C
	→				ACC ⇄	to R	
					BNG DOWN		
					RCH ⇄	increase	For/backtrack
	ACC ←				R ⇄	R=?	
	→				R ⇄	R=1 sq.	
				TOP ⇄	BNG DOWN		
					SLICE		
					G		
					S_{14}		
					T ⇄	higher	
		TIM ←			TIM ⇄	wait	
		→			T ⇄	T=2-	
					SLICE		
					C ⇄	C=3-	
					C ⇄	C=4-	
		TIM ⇄			TIM ⇄	wait	
					C ⇄	C=5?	
		FEELS ⇄			FEELS ⇄	better	
					T ⇄	T=2?	
		BAL ←		$-S_9$ ←	$-S_9$ ⇄	station-ary	
		→			S_{14}		
31. -+ 414-444	↑SPD ←				T ⇄	higher	T,R
	→				T ⇄	lower	
					BNG UP		
	ACC ←				T ⇄	lower	
	→				RCH ⇄	to R.	
					B		

APPENDIX LXX (continued)

Main Goal	Subgoal A	Subgoal B	Subgoal C	Read in Variables	Call Variables	A/V	CRT Order of Call
					R	R=1 sq.	
					T	higher	Rev
					EYE		
					T	higher	
					BNG DOWN		
					EYE		
			TEST T		T	T=1,2,3	
					T	T=1+	
32. - 445-477					T		T,R,C
	ACC = -		TEST HD		HD		
					EYES		
					SLICE		
	ACC = -				BNG UP		For
					HD		
					RCH		
					B		
					R	R=1 sq.	
		TIM			TIM	wait	
					HD		
					RCH		
					C	C=5-	
					RCH		
					C	C=5-	
	↑SPD				T	T=3	
						higher	
					RCH		
					B		
	↓SPD				T	lower	
					T	lower	
	ACC = -				E	E=2-4	
						bent	
						elbow	
					C	C=5	

APPENDIX LXX (continued)

Main Goal	Subgoal A	Subgoal B	Subgoal C	Read in Variables	Call Variables	A/V	CRT Order of Call
					SLICE		
				TIRED/ ←	HD		
				SORE			
33. ?					BNG UP		
478-499					RCH		
				LEAN ⇄		to L	-
							Rev
	ACC ←				RCH		
	→	FORM?			SORE/		
					TIRED		
34. -+					B ⇄	B=1	
500-519						throwing	C,R
						action	
					G ⇄	G=1	
	ACC = - ←	BAL ←			BAL		
		→			C ⇄	C=5-	
	↑ACC ←				R		
	⇄				HD		Rev
	ACC →					to R.	
35. -					RCH		
520-556					T ⇄	lower	T,C
					RCH		
					RCH		
					C ⇄	C=5	
					B ⇄	B=1	Mix
			TEST T ⇄		T ⇄	T=2-	
	↑ACC ←				T ⇄	T=1+	
	→				T ⇄	T=3-	
					B		
					T ⇄	-	
					T ⇄	T=2-	
					T ⇄	T=3-	

APPENDIX LXX (continued)

Main Goal	Subgoal A	Subgoal B	Subgoal C	Read in Variables	Call Variables	A/V	CRT Order of Call
					RCH		
					T		
					C ⇄	C=5-	
	ACC = -				EYE		
					WIND ⇄	to R	
					T ⇄	T=1	
	↑ACC(goal) ←	←	←	←	WIND		
	→	FORM					
36. ?-+					T ⇄	lower	
Test			T or HD ←	←	HD		T,R
		TIM ←	←	←	TIM ⇄	wait	
		→	→	→	EYE		
					SLICE		
					R ⇄	R=1 sq.	
	ACC = - ⇆	FEEL ←	←	←	T →	better	
					ARCH ←		
	ACC = - ←	←	←	←	B ⇄	throwing	
	→	→	→	→		action	Mix
	ACC = - ←	←	←	←	WIND		
	→	FORM →	→	→	FORM →	+	

APPENDIX LXXI

Subject 6: SYNOPSIS OF VERBAL-MOTOR BEHAVIOR GRAPH

- - +		?		+ + -	
CRT	Order of Call	CRT	Order of Call	CRT	Order of Call
1. R,T	Rev	3. -	-	6. R	Rev
2. T	-	14. T	1 early var.	8. T	For
4. T	Rev	17. T,R,C	Rev	9. T,C	Rev
5. T,R	Rev	20. T	For	10. T	For
7. T,C	For	26. T,C	Rev	11. T,R	Rev
12. R,T,C	Rev	27. T,R	Mix	15. T	Rev
13. R,T	Rev	29. T	Mix	18. T,C	Rev
16. T	For/Back	33. -	Rev	23. C,T,R	Rev/ Back
19. T,R	Mix	36. T,R	Mix	25. T,C,R	Rev/ Back
21. T	For			28. -	Rev
22. T,C	For			30. R,T,C	For/ Back
24. C,R,T	Mix				
31. T,R	Rev				
32. T,R,C	For/Back				
34. C,R	Rev				
35. T,C	Mix				
TOTALS T = 4 RT = 2 TR = 3 TC = 3 CR = 1 RTC = 1 CRT = 1 TRC = 1	Mix = 3 For = 5 Rev = 7	T = 3 TR = 2 TC = 1 TRC = 1	Mix = 3 For = 1 Rev = 3	R = 1 T = 3 TC = 2 TR = 1 CTR = 1 TCR = 1 RTC = 1	Mix = 1 For = 3 Rev = 8

APPENDIX LXXII

Subject 6: ANALYSIS OF VERBAL PROBLEMS BY MOTOR PLOT SCORES*

Problem	Episodes	#Episodes	Sol. Code	Range of Scores	Motor Plot Total Score	Initial Score	Final Score	Mean Score
1	1-9	9	2	32-41	334	33	37	37.11
2	10-13	4	4	36-39	151	38	38	37.75
3	14-17	4	1	41-42	166	42	41	41.50
4	18-33	16	4	30-44	628	41	42	39.25
5	34-50	17	4	36-48	694	36	42	40.82
6	51-58	8	3	42-48	351	42	48	43.87
7	59-69	11	4,7	36-48	451	48	36	41.00
8	70-78	9	3	36-42	372	42	42	41.33
9	79-88	10	3	36-45	423	36	39	42.30
10	89-93	5	3	45-45	225	45	45	45.00
11	94-104	11	3	39-45	483	45	45	43.90
12	105-111	7	4	34-57	322	51	34	46.00
13	112-123	12	4	39-45	521	45	39	43.41
14	124-133	10	1	45-51	456	45	45	45.60
15	134-143	10	3	40-45	439	45	45	43.90
16	144-173	30	4	30-45	1179	42	45	39.30
17	174-183	10	1,7	39-45	438	45	45	43.80
18	184-187	4	3	41-51	188	41	45	47.00
19	188-202	15	4	38-47	651	39	45	43.40
20	203-217a	15	1	42-45	672	45	45	44.80
21	217b-225	8	4	38-45	342	45	45	42.75
22	226-238	13	5	41-54	585	42	45	45.00
23	239-263	25	5	36-51	1123	42	45	44.92
TR	263-269	6	6	33-51	255	45	36	42.50
24	270-277	8	4,7	41-57	379	41	51	47.37
25	278-325	48	3	31-54	2045	45	39	42.60
26	326-343	18	1	35-58	784	37	46	43.55
27	344-365	22	1	33-51	918	37	39	41.72
28	366-369	4	3	39-48	169	39	48	42.25

APPENDIX LXXII (continued)*

Problem	Episodes	#Episodes	Sol. Code	Range of Scores	Motor Plot Total Score	Initial Score	Final Score	Mean Score
29	370-376	7	1	37-45	283	45	45	40.42
30	377-413	37	3	32-51	1473	42	33	39.81
31	414-444	31	4	25-48	1149	42	42	37.06
32	445-477	33	2	28-58	1322	42	36	40.06
33	478-498	21	2	32-42	761	39	34	36.23
34	499-519	20	4	31-57	833	36	40	41.65
35	520-556	37	2	31-52	1590	40	42	42.97
36	557-566	10	1,4,7	43-52	466	46	46	46.60

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*The legend for abbreviations and symbols is found in Appendix VI.

APPENDIX LXXIII

Subject 6: ANALYSIS OF HIGHEST SCORES DURING EACH PROBLEM *

Problem	Episode	Score	Analysis of Verbal Data Around Highest Score	Result
1	7,8	41	NC, R	A/V, +, Test 1 Var.
2	11	39	F	+, 1 Var.
3	14,15	42	OC + S	+, Comb. Vars.
4	28	44	NC, T (27)	+, Test 1 Var. A/V
5	37	48	F + T_3	A/V, Comb. Vars.
6	52	48	OC	Test 1 Var.
7	59,64,66	48	T_3+EYE+C_3+BAL+Lower over net	Comb. Vars. & Props A/V, +
8	scattered	42	B+T_3+P+↓SPD+W; T+B	A/V, A/E, comb.
9	82,86,87	45	$T = T_1 - T_3$	Test T, A/V
10	scattered	45	RCH+T+B+winding action	Comb., +
11	scattered	45	FOR swing + T_3 + F↑ +R_1	A/V, Comb., +
12	106	57	T↓ + ↓ SPD = ↑ ACC	A/C, Comb.
13	scattered	45	R_1+TIM (slower), + T_2+ACC +W_{firm}	Comb. Props.
14	129	51	TIM = T_2	A/E, Comb. elems.
15	scattered	45	$-T_3$ + $-T_2$ + RCH + B	A/V, Comb.
16	169-173	45	T_3+RCH+B+ ↑SPD+ ↑ACC	Comb. into elems.
17	scattered	45	B+T_3+R+HD+C_1	A/V, Comb.
18	185,6	51	-T + RCH + TIM	Comb. into elem.
19	198	47	NC, T (196)	Test 1 Var.
20	scattered	45	T_3+OC+ +↑SPD+TIM (wait) +C+RCH+ACC+P	enlarging # Props. Comb. elems.
21	scattered	45	MOC+B+-WIND+ ↑SPD+T+BAL TIM (wait)	enlarging # Props. Combine elems.

*Abbreviations and symbols are found in Appendix VI.

APPENDIX LXXIII (continued)*

Problem	Episode	Score	Analysis of Verbal Data Around Highest Score	Result
22	232	54	NC, RCH + BAL (229)	Comb., narrow
23	256,7,9 262	51	NC, HD, lower over the net	+, 1 goal
TR	267	51	NC	Test
24	276	57	NC, lower over the net	+, 1 goal, narrow
25	291	54	$C_{\text{too far in front}}$	-, Test 1 var.
26	341	58	EYE	1 Var, +
27	350	51	FEEL, +	+, 1 elem
28	369	48	FEEL, +	+, 1 elem
29	376	45	LEVER (shorter), +G+SLICE to L, + WIND	A/V, Comb. into elems.
30	399	51	NC, G (396)	Test 1 Var.
31	443	48	NC, T + EYE (444)	Comb. Vars.
32	449	58	NC, T + EYE (447,451)	Comb. Vars. Test
33	489	42	LEAN	Test 1 Var., +
34	510	57	NC, G (503, C + BAL (512)	Test 1 Var., Comb.
35	534,6,9, 41,44	52	↑SPD + T_2, SPD = T_2	A/V, Comb., A/E
36	561,2	52	NC, T_2 (557) + TIM (wait) T = TIM	A/E

*Abbreviations and symbols are found in Appendix VI.

APPENDIX LXXIV

Subject 6: INCREASES AND DECREASES IN MOTOR PERFORMANCE SCORES WITHIN AND BETWEEN DAYS

Days	Increases	Decreases	Scores Remaining the Same	Total
Between	2 (40.00%)	3 (60.00%)	0 (00.00%)	5
Within	10 (32.25%)	9 (29.03%)	12 (38.70%)	31
Total	12 (33.33%)	12 (33.33%)	12 (33.33%)	36

APPENDIX LXXV

Subject 6: THE EFFECTS OF REST UPON THE WITHIN DAY INCREASES AND DECREASES OF MOTOR PERFORMANCE SCORES

Increase With Rest	Increase Without Rest	Decrease With Rest	Decrease Without Rest	Stays Same With Rest	Stays Same Without Rest	Total
0 (00.00%)	10 (32.25%)	0 (00.00%)	9 (29.03%)	1 (3.22%)	11 (35.48%)	31
Total	10 (32.25%)		9 (29.03%)		12 (38.70%)	31

APPENDIX LXXVI

Subject 6: ANALYSIS OF VERBAL PROBLEMS BY ACCURACY/SPEED SCORES

Problem	#Episodes	Raw Score Accuracy	Raw Score Speed	Accuracy Ratio (6 max)	Speed Ratio (4 max)	Sol.Code[a]
1	9	7	3	.77	.33	2
2	4	1	1	.25	.25	4
3	4	2	1	.50	.25	1
4	16	21	12	1.31	.75	4
5	17	6	4	.35	.23	4
6	7	4	4	.57	.57	3
7	10	4	4	.40	.40	4,7
8	9	9	7	1.00	.77	3
9	10	6	5	.60	.50	3
10	5	4	4	.80	.80	3
11	11	4	3	.36	.27	3
12	7	9	3	1.28	.42	4
13	12	4	4	.33	.33	4
14	10	8	7	.80	.70	1
15	10	7	7	.70	.70	3
16	30	25	19	.83	.63	4
17	10	14	10	1.40	1.00	1,7
18	4	1	1	.25	.25	3
19	15	9	11	.60	.73	4
20	15	25	15	1.66	1.00	1
21	8	5	4	.62	.50	4
22	13	10	9	.76	.69	5
23	25	24	26	.96	1.04	5
TR	6	11	8	1.83	1.33	6
24	8	11	8	1.37	1.00	4,7
25	48	32	29	.66	.60	3
26	18	25	17	1.38	.94	1
27	22	24	12	1.09	.54	1
28	4	2	4	.50	1.00	3
29	7	1	1	.14	.14	3
30	37	33	35	.89	.94	1
31	31	40	25	1.29	.80	3
32	33	25	24	.75	.72	4
33	20	25	21	1.25	1.05	2
34	20	12	7	.60	.35	2
35	37	33	24	.89	.64	4
36	10	5	5	.50	.50	2

[a] See Appendix VI for the key to the solution codes.

APPENDIX LXXVII

Subject 6: INCREASES AND DECREASES IN ACCURACY AND SPEED SCORES WITHIN AND BETWEEN DAYS

ACCURACY

Days	Increases	Decreases	Scores Remaining the Same	Total
Between	1 (20.00%)	1 (20.00%)	3 (60.00%)	5
Within	11 (35.48%)	9 (29.03%)	11 (35.48%)	31
Total	12 (33.33%)	10 (27.77%)	14 (38.88%)	36

SPEED

Days	Increases	Decreases	Scores Remaining the Same	Total
Between	1 (20.00%)	1 (20.00%)	3 (60.00%)	5
Within	8 (25.80%)	9 (29.03%)	14 (45.16%)	31
Total	9 (25.00%)	10 (27.77%)	17 (47.22%)	36

APPENDIX LXXVIII

Subject 6: THE EFFECTS OF REST UPON THE WITHIN-DAY INCREASES AND DECREASES OF ACCURACY AND SPEED SCORES

ACCURACY

Increase With Rest	Increase Without Rest	Decrease With Rest	Decrease Without Rest	Stays Same With Rest	Stays Same Without Rest	Total
1 (3.22%)	10 (32.25%)	0 (00.00%)	9 (29.03%)	0 (00.00%)	11 (35.48%)	31
Total	11 (35.47%)		9 (29.03%)		11 (35.48%)	31

SPEED

Increase With Rest	Increase Without Rest	Decrease With Rest	Decrease Without Rest	Stays Same With Rest	Stays Same Without Rest	Total
1 (3.22%)	7 (22.58%)	0 (00.00%)	9 (29.03%)	0 (00.00%)	14 (45.16%)	31
Total	8 (25.80%)		9 (29.03%)		14 (45.16%)	31

APPENDIX LXXIX

COMPARISON OF SUBJECTS: INITIAL WALLBOARD TEST

Subject	Raw Wallboard Score	T-Score	Percentile
1	22	47	40
2	15	38	12
3	25	50	51
4	28	54	70
5	12	4	7
6	26	52	59

APPENDIX LXXX

COMPARISON OF SUBJECTS: HEWITT SERVE ACCURACY TESTS

Subject	Day							Total	Average Score
	1	2	3	4	5	6	7		
1	4	0	9	8	4	2	12	39	5.57
2	10	8	18	19	6	11	12	84	12.00
3	7	6	13	6	6	8	2	48	6.86
4	10	9	14	18	7	6	10	74	10.57
5	6	7	5	3	2	3	11	37	5.29
6	4	12	13	3	19	5	--	56	9.33

APPENDIX LXXXI

COMPARISON OF SUBJECTS: HEWITT SERVE SPEED TESTS

Subject	Day							Total	Average Score
	1	2	3	4	5	6	7		
1	2	0	9	12	3	3	11	40	5.71
2	6	7	10	8	5	6	5	47	6.71
3	4	6	6	7	3	6	3	35	5.00
4	6	3	7	12	4	3	6	41	5.86
5	5	5	6	2	2	3	7	30	4.29
6	4	10	10	5	12	5	-	46	7.67

APPENDIX LXXXII

COMPARISON OF SUBJECTS: MEAN DAILY ACCURACY SCORES

Subject	Day							Total Mean Acc. Score	Aver. Mean Acc. Score
	1	2	3	4	5	6	7		
1	.55	.38	.53	.66	.43	.82	.88	4.25	.61
2	.87	.82	1.10	.72	.77	.78	.73	5.79	.83
3	.79	.52	1.01	.83	.57	.66	.53	4.91	.70
4	.30	.85	1.06	1.01	1.15	.93	1.93	7.23	1.03
5	.95	.61	.31	.24	.44	.43	.80	3.78	.54
6	.67	.86	1.02	.84	1.01	.75	-	5.15	.86

APPENDIX LXXXIII

COMPARISON OF SUBJECTS: MEAN DAILY SPEED SCORES

Subject	Day							Total Mean Acc. Score	Aver. Mean Acc. Score
	1	2	3	4	5	6	7		
1	.64	.29	.56	.72	.45	.80	.88	4.34	.62
2	.63	.56	.69	.51	.54	.55	.43	3.91	.56
3	.58	.48	.55	.64	.30	.50	.46	3.51	.51
4	.23	.39	.72	.69	.85	.67	1.00	4.55	.65
5	.63	.39	.25	.19	.27	.31	.61	2.65	.38
6	.43	.65	.90	.63	.86	.54	-	4.01	.67

APPENDIX LXXXIV

COMPARISON OF SUBJECTS: RANGE OF MOTOR SCORES

Subject	Range of Motor Scores	Days
1	24-59	2,2
2	8-52	1,7
3	13-44	1,6
4	31-63	5, (2, 3, 4, 5)
5	12-58	1,4
6	25-58	5, (4, 5)

APPENDIX LXXXV

PERFORMANCE SCORES BY ALL SUBJECTS ON ALL MOTOR TESTS

Subject	Rank	Motor Performance	Hew. Acc.	Hew. Spd.	Av.Mean Acc.	Av. Mean Spd.
1	4	59	5.57	5.71	.61	.62
2	6	52	12.00	6.71	.83	.56
3	3	44	6.86	5.00	.70	.51
4	1	63	10.57	5.86	1.03	.65
5	2	58	5.29	4.29	.54	.38
6	5	58	9.33	7.67	.86	.67

APPENDIX LXXXVI

RANK ORDER BY SUBJECTS ON THE MOTOR SCORES

Test	Rank Order					
	1	2	3	4	5	6
Wallboard	4	6	3	1	2	5
Motor Perf.	4	1	5	6	2	3
Hewitt Acc.	2	4	6	3	1	5
Hewitt Spd.	6	2	4	1	3	5
Av. Mean Acc.	4	6	2	3	1	5
Av. Mean Spd.	6	4	1	2	3	5

APPENDIX LXXXVII

ALL SUBJECTS: TOTAL TEST RANKING

Rank Order	Subject	Initial Placement Test (Wallboard)
1	4	4
2	6	6
3	1	3
4	2	1
5	3	2
6	5	5

APPENDIX LXXXVIII

ALL SUBJECTS: NUMBER OF VARIABLES READ IN DAILY

Day	SUB. 1	SUB. 2	SUB. 3	SUB. 4	SUB. 5	SUB. 6
1	20	11	21	21	17	20
2	12	21	15	21	16	11(10 new)
3	10	7	12	3	9	7
4	4	11	9	2	6	11
5	4	1	3	10	6	4
6	3	4	2	3	6	1
7	2,1	0	0	0	0	-

APPENDIX LXXXIX

ALL SUBJECTS: COMPARISON OF BETWEEN DAY INCREASES AND DECREASES IN MOTOR PERFORMANCE SCORES

Subject	Increases	Decreases	Same	Totals
1	1 (16.66%)	5 (83.33%)	0 (00.00%)	6
2	3 (50.00%)	3 (50.00%)	0 (00.00%)	6
3	1 (16.66%)	4 (66.66%)	1 (16.66%)	6
4	3 (50.00%)	2 (33.33%)	1 (16.66%)	6
5	2 (33.33%)	4 (66.66%)	0 (00.00%)	6
6	2 (33.33%)	3 (50.00%)	0 (00.00%)	5
Totals	12 (34.28%)	21 (60.00%)	2 (5.71%)	35

APPENDIX XC

ALL SUBJECTS: WITHIN-DAY INCREASES AND DECREASES IN MOTOR PERFORMANCE SCORES

Subject	Increases	Decreases	Same	Totals
1	15 (46.87%)	12 (37.50%)	5 (15.62%)	32
2	14 (38.88%)	15 (41.66%)	7 (19.44%)	36
3	9 (40.90%)	8 (36.36%)	5 (22.72%)	22
4	16 (50.00%)	13 (40.62%)	3 (9.37%)	32
5	17 (45.94%)	14 (37.83%)	6 (16.21%)	37
6	10 (32.25%)	9 (29.03%)	12 (38.70%)	31
Total	81 (42.63%)	71 (37.36%)	38 (20.00%)	190

APPENDIX XCI

ALL SUBJECTS: THE EFFECTS OF REST UPON THE WITHIN-DAY INCREASES AND DECREASES OF MOTOR PERFORMANCE SCORES

Subject	Increase With Rest	Increase Without Rest	Decrease With Rest	Decrease Without Rest	Stays Same With Rest	Stays Same Without Rest	Total
1	5 (15.62%)	10 (31.25%)	3 (9.37%)	9 (28.12%)	0 (00.00%)	5 (15.62%)	32
2	2 (5.55%)	12 (33.33%)	5 (13.88%)	10 (27.77%)	2 (5.55%)	5 (13.88%)	36
3	3 (13.63%)	6 (27.27%)	1 (4.54%)	7 (31.81%)	0 (00.00%)	5 (22.72%)	22
4	1 (3.12%)	14 (43.75%)	3 (9.37%)	11 (34.37%)	1 (3.12%)	2 (6.25%)	32
5	2 (5.40%)	14 (37.83%)	1 (2.70%)	14 (37.83%)	1 (2.70%)	5 (13.51%)	37
6	0 (00.00%)	10 (32.25%)	0 (00.00%)	9 (29.03%)	1 (3.22%)	11 (35.48%)	31
Total	13 (6.84%)	66 (34.73%)	13 (6.84%)	60 (31.57%)	5 (2.63%)	33 (17.36%)	190

APPENDIX XCII

ALL SUBJECTS: BETWEEN DAY INCREASES AND DECREASES IN ACCURACY AND SPEED SCORES

ACCURACY

Subject	Increases	Decreases	Remain the Same	Totals
1	1 (16.66%)	1 (16.66%)	4 (66.66%)	6
2	1 (16.66%)	4 (66.66%)	1 (16.66%)	6
3	1 (16.66%)	2 (33.33%)	3 (60.00%)	6
4	0 (00.00%)	1 (16.66%)	5 (83.33%)	6
5	0 (00.00%)	1 (16.66%)	5 (83.33%)	6
6	1 (20.00%)	1 (20.00%)	3 (60.00%)	5
Total	4 (11.42%)	10 (28.57%)	21 (60.00%)	35

SPEED

Subject	Increases	Decreases	Remain the Same	Totals
1	2 (16.66%)	1 (16.66%)	4 (66.66%)	6
2	1 (16.66%)	4 (16.66%)	1 (16.66%)	6
3	2 (33.33%)	1 (16.66%)	3 (60.00%)	6
4	0 (00.00%)	0 (00.00%)	6 (100.00%)	6
5	0 (00.00%)	1 (16.66%)	5 (83.33%)	6
6	1 (20.00%)	1 (20.00%)	3 (60.00%)	5
Total	5 (14.28%)	8 (22.85%)	22 (62.85%)	35

APPENDIX XCIII

ALL SUBJECTS: WITHIN-DAY INCREASES AND DECREASES IN ACCURACY AND SPEED SCORES

ACCURACY

Subject	Increases	Decreases	Remain the Same	Totals
1	8 (24.24%)	1 (3.03%)	24 (72.72%)	33
2	9 (25.00%)	10 (27.77%)	17 (47.22%)	36
3	5 (21.73%)	4 (17.39%)	14 (60.86%)	23
4	15 (46.87%)	4 (12.50%)	13 (40.82%)	32
5	13 (35.13%)	8 (21.62%)	16 (43.24%)	37
6	11 (35.48%)	9 (29.03%)	11 (35.48%)	31
Total	61 (31.77%)	36 (18.75%)	95 (49.47%)	192

SPEED

Subject	Increases	Decreases	Remain the Same	Totals
1	9 (27.27%)	1 (3.03%)	23 (69.69%)	33
2	7 (19.44%)	12 (33.33%)	17 (47.22%)	36
3	3 (13.04%)	4 (17.39%)	16 (69.56%)	23
4	14 (43.75%)	3 (9.37%)	15 (46.87%)	32
5	9 (24.32%)	7 (18.91%)	21 (56.75%)	37
6	8 (25.80%)	9 (29.03%)	14 (45.16%)	31
Total	50 (26.04%)	36 (18.75%)	106 (55.20%)	192

APPENDIX XCIV

ALL SUBJECTS: THE EFFECTS OF REST UPON THE WITHIN-DAY INCREASES AND DECREASES OF ACCURACY AND SPEED SCORES

ACCURACY

Subject	Increase With Rest	Increase Without Rest	Decrease With Rest	Decrease Without Rest	Stays Same With Rest	Stays Same Without Rest	Total
1	2 (6.06%)	6 (18.18%)	0 (00.00%)	1 (3.03%)	7 (21.21%)	17 (51.51%)	33
2	5 (13.88%)	4 (11.11%)	3 (8.33%)	7 (19.44%)	2 (5.55%)	15 (41.66%)	36
3	1 (4.34%)	4 (17.39%)	1 (4.34%)	3 (13.04%)	7 (30.43%)	7 (30.43%)	23
4	0 (0.00%)	15 (46.87%)	1 (3.12%)	3 (9.37%)	4 (12.50%)	9 (28.12%)	32
5	2 (5.40%)	5 (13.51%)	1 (2.70%)	8 (21.62%)	1 (2.70%)	20 (54.05%)	37
6	1 (3.22%)	10 (32.25%)	0 (0.00%)	9 (29.03%)	0 (0.00%)	11 (35.48%)	31
Total	11 (5.72%)	44 (22.91%)	6 (3.12%)	31 (16.14%)	21 (10.93%)	79 (41.14%)	192

SPEED

Subject	Increase With Rest	Increase Without Rest	Decrease With Rest	Decrease Without Rest	Stays Same With Rest	Stays Same Without Rest	Total
1	1 (3.03%)	8 (24.24%)	1 (3.03%)	0 (00.00%)	4 (12.12%)	19 (57.57%)	33
2	3 (8.33%)	4 (11.11%)	3 (8.33%)	9 (25.00%)	4 (11.11%)	13 (36.11%)	36
3	0 (0.00%)	3 (13.04%)	0 (0.00%)	4 (17.39%)	5 (21.73%)	11 (47.82%)	23
4	0 (0.00%)	13 (40.62%)	1 (3.12%)	3 (9.37%)	4 (12.50%)	11 (34.37%)	32
5	2 (5.40%)	11 (29.72%)	1 (2.70%)	7 (18.91%)	1 (2.70%)	15 (40.54%)	37
6	1 (3.22%)	7 (22.58%)	0 (0.00%)	9 (29.03%)	0 (0.00%)	14 (45.16%)	31
Total	7 (3.64%)	46 (23.95%)	6 (3.12%)	32 (16.66%)	18 (9.37%)	83 (43.22%)	192

APPENDIX XCV

ALL SUBJECTS: ANALYSIS OF EPISODES OF HIGHEST SCORES BY GENERAL PLAN

Subject	Pattern
1	Positive goals involving 1 variable to broad goals involving a large # of values, vars. and props.; combination of values, vars. and props. into larger elems., narrowing large # of values, vars. and props. into fewer ones by eliminating unsuccessful vars. or combining acceptable vars. and props. into elem.; testing of individual props. Positive goal statements. Negative and positive evaluations.
2	Early combination of elems., equivalency, combination of values, vars., props. into elems., testing of individual props. at the end. Positive goal statements. Negative and positive evaluations.
3	1 var. to combination of vars., to equivalency of vars., to combining of values and vars. into larger props.; assigning of values to vars., variety of combinations, large number of props. narrowed to few large props. and larger elems., testing 1 var. while continuing to narrow down number of props. tested.
4	A few vars. to a large number of single vars., to combining them singly, to combining them into larger elems.; assigning equivalency, into a large elem. called "everything together." Primarily positive goals. Uses both negative and positive evaluations.
5	Assigns values to vars., tests, positive goals, combining vars., assigning equivalencies, testing one variable, combining props. into elems., testing vars., combining into larger elems., assigning equivalencies testing 1 var. Most goals are positively stated. Negative and positive evaluations.
6	Assigns values, tests vars., combines vars., combines vars. and props., assigns equivalencies, combines props. into elems., tests props. (re-cycles through the above processes a number of times), narrows down props. and elems. and assigns new equivalencies and tests, investigates single variables, assigns equivalencies.

APPENDIX XCVI

ALL SUBJECTS: MODEL CHANGES

PATTERN CHANGES

Order of CRT Variables	Forward Calling of Variables			Reverse Calling of Variables			Mixed Calling of Variables		
	-	?	+	-	?	+	-	?	+
1. T,R,C	7	1	3	4	1	4	4	0	7
2. T,R,C	3	1	6	4	3	4	5	5	4
3. T,R,C	1	4	2	0	4	3	1	2	1
4. T,C,R	7	1	2	6	0	3	11	2	6
5. T,C,R	2	1	2	3	2	8	1	4	1
6. R,T,C	5	1	3	8	2	8	3	3	1
Total	25	9	18	25	12	30	25	16	20
Total			52			67			61

Subject	Order of T	Order of R	Order of C	#+	#-	#?
1	2,3,1	2,1,2	3,1,4,3,1	18	17	3
2	2,3,1	4,1	3,2,4,1	18	12	9
3	1,2,3	3,1,2	1,4,3,5	6	2	18
4	2,3,1,2	1,Twist	1,5,2,4,1	11	25	3
5	1,3,2	--	1,4,2,L,3	17	9	14
6	3,2,1	3,2,1,L.	4,3,5,1	11	16	9
Totals				92	106	59

APPENDIX XCVII

ALL SUBJECTS: ANALYSIS OF PROPERTIES

Property	S1	S2	S3	S4	S5	S6
ACC	6	4	2	7	3	7
ANG				15	14	
ARCH		28	19	3	22	21
B	2	20		17	37	12
BAL					34	16
BNG DOWN				6		
BNG UP		27		8	26	24
C	4	15	9	11	15	17
CON		24	25	35	10	
COOR					31	
DOA				31		
DR		13				
E	16	23	5	30	12	23
EYES			6			15
F	21	7	7	26	25	9
FB						33
FEEL			1	25	19	1
FOB					36	
FS				18		19
G	25	11	3	9	16	
G_t					8	2
H			8	32	17	
HD	9	14		21		5
H_{Di}	11					
HU						25
HS		22				
I	15					
LEAN		9	23	12	24	32
LEVER						29
LIFT				10		
MF					35	
ML					5	
MOC	5				13	13
MOM					28	
NERVOUS				13	7	
OC	8	21	22	29	2	10
OT				20		
P		10		34		22
PEN			10			
"PP Idea"	22					
PR			24			
R	14	2	13	24	27	3
RCH	18	25	27	2	18	18
RHY	1					

APPENDIX XCVII (continued)

Property	S1	S2	S3	S4	S5	S6
RW			21		20	
S			15		29	
S_9	20	5				
S_{13}		17		19		31
S_{14}		6	20			14
S_{15}					23	26
SIM	13	20				
SM				4		
SPD	10	3	12	14	1	8
SPIN					21	27
SWAY				23		
T	3	1	4	1	4	6
TI				28		
TIM	12	12	11	22	11	20
TK	17		18	27	9	
TOP	24	26	14	16		30
W	7	16	17		32	4
W_{hor}		7		5	6	17
WA	23					
WB	19	18	16		30	
WIND	27	29		33	33	28
WS				36		
WU	26					

APPENDIX XCVIII

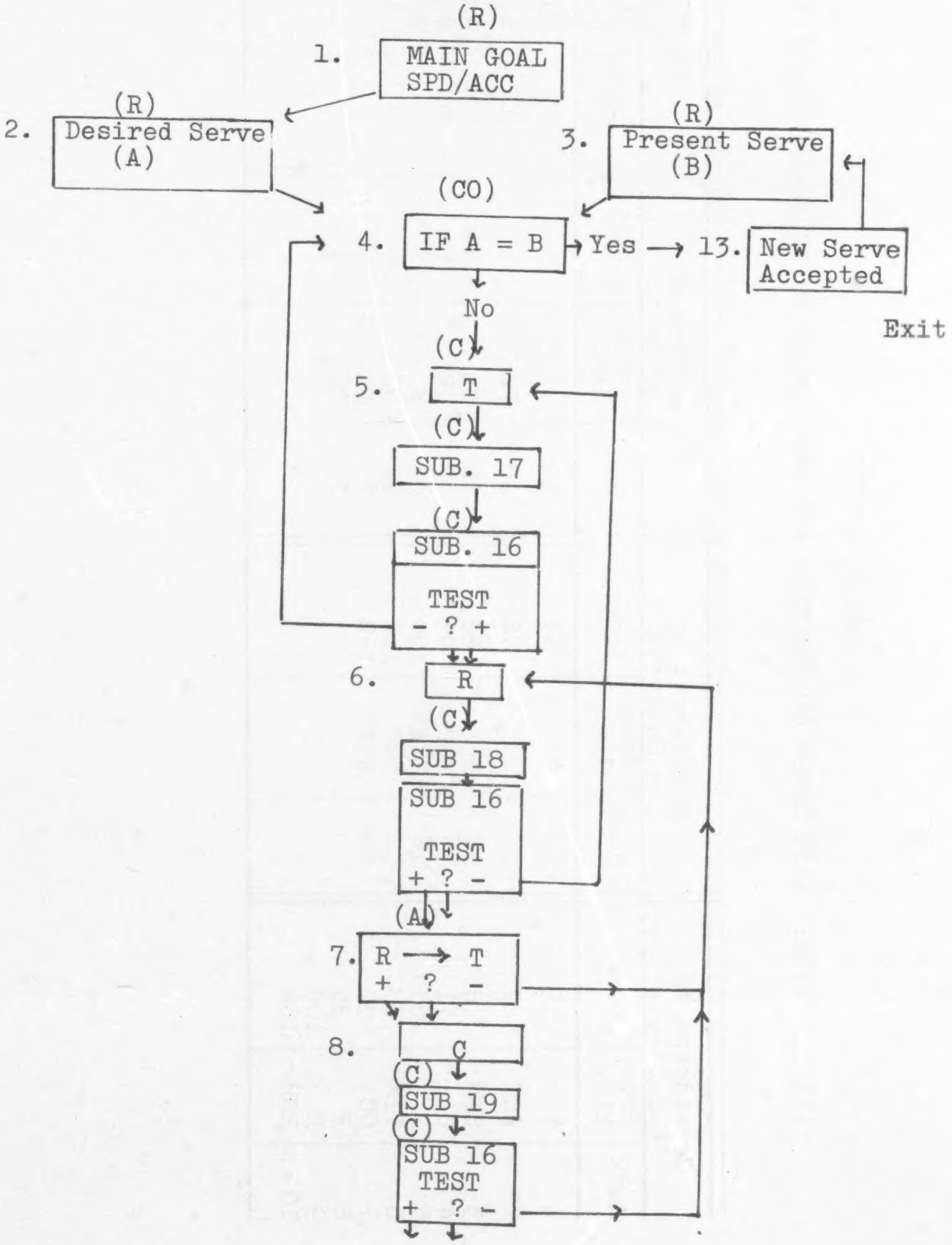
ALL SUBJECTS: RANK ORDER OF ELEMENTS AND PROPERTIES TO DETERMINE PRIORITY

Considered by 6 Subjects			Considered by 5 Subjects			Considered by 4 Subjects			Considered by 3 Subjects		
Rank	Prop. Ele.	Score	Rank	Prop. Ele.	Score	Rank	Prop. Ele.	Score	Rank	Prop. Ele.	Score
1	T	19	12	G	64	19	W_{hor}	35	27	MOC	31
2	ACC	29	13	W	76	20	FEELS	46	28	S_{14}	40
3	SPD	48	14	B	88	21	HD	49	29	H	57
4	C	71	15	ARCH	93	22	TK	71	30	P	66
5	R	83	16	LEAN	100	23	W	71	31	S_{13}	67
6	TIM	88	17	TOP	110	24	WB	83			
7	OC	92	18	WIND	150	25	BNG UP	85			
8	F	95				26	CON	94			
9	E	109									
10	RCH	108									

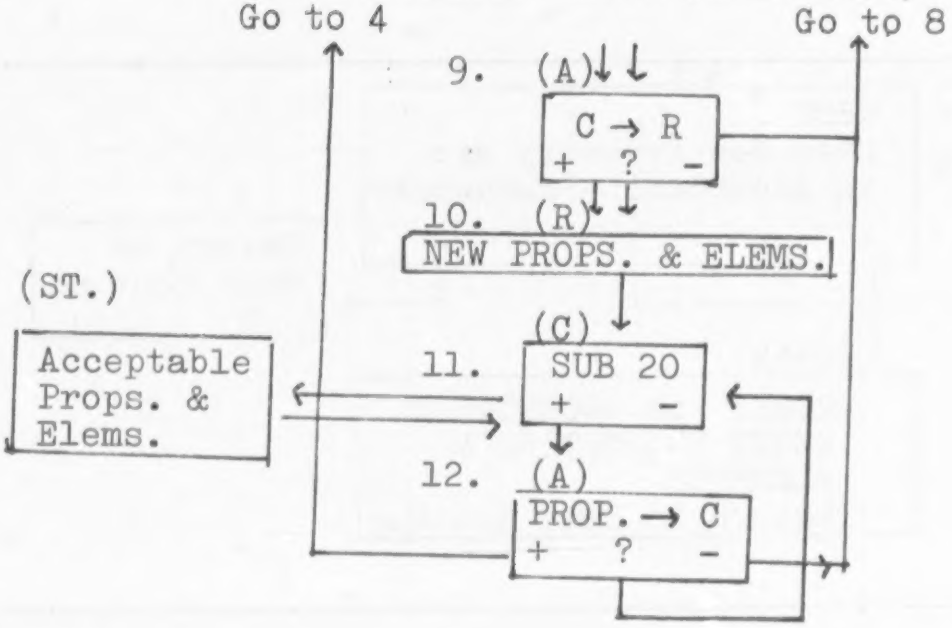
APPENDIX XCVIV

REVISED GSPS MODEL DIAGRAMMED

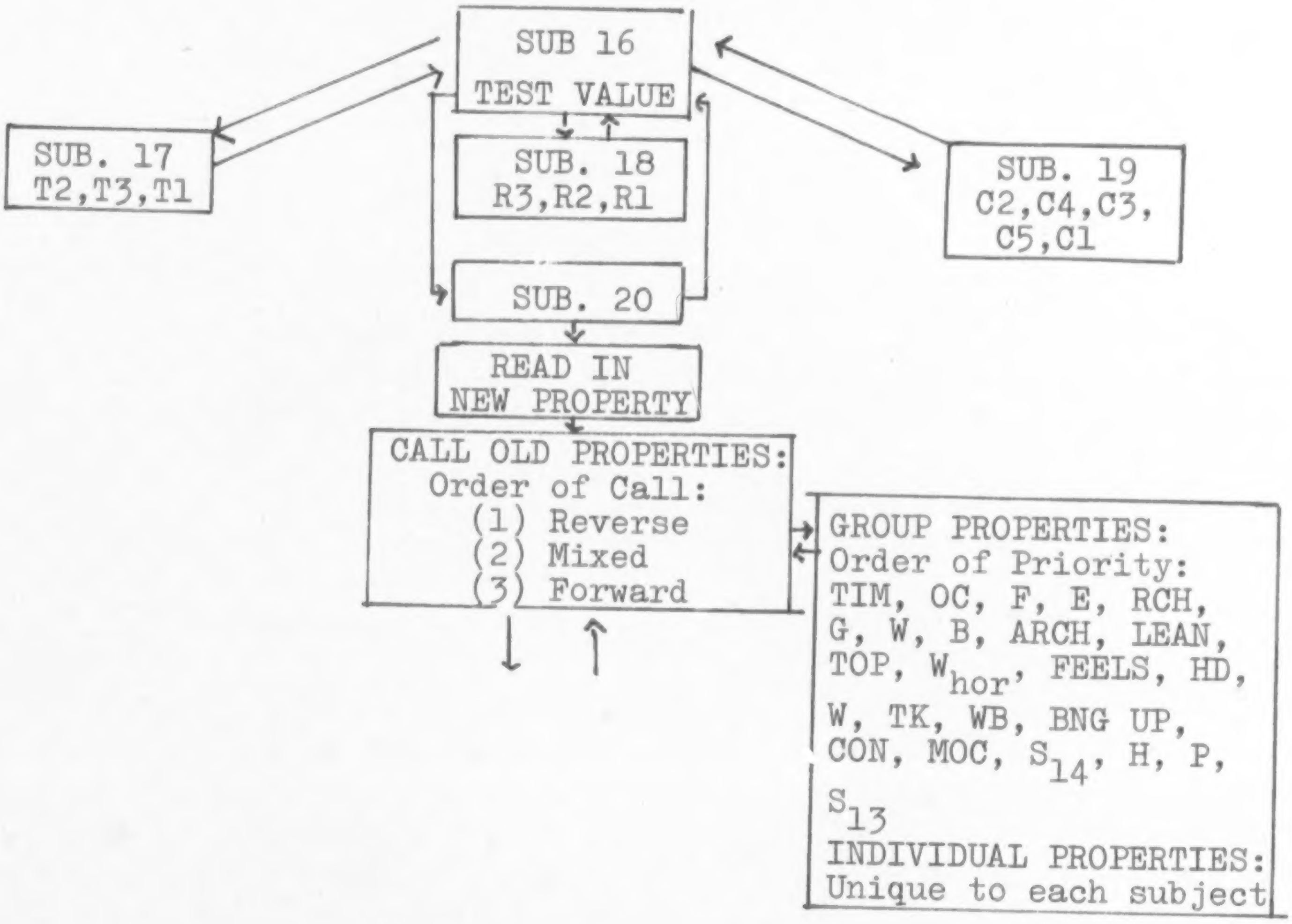
Main Routine


(R)
1. MAIN GOAL SPD/ACC
(R)
2. Desired Serve (A)
(R)
3. Present Serve (B)
(CO)
4. IF A = B
Yes
13. New Serve Accepted
Exit
No
(C)
5. T
(C)
SUB. 17
(C)
SUB. 16
TEST
- ? +
6. R
(C)
SUB 18
SUB 16
TEST
+ ? -
(A)
7. R → T
+ ? -
8. C
(C)
SUB 19
(C)
SUB 16
TEST
+ ? -

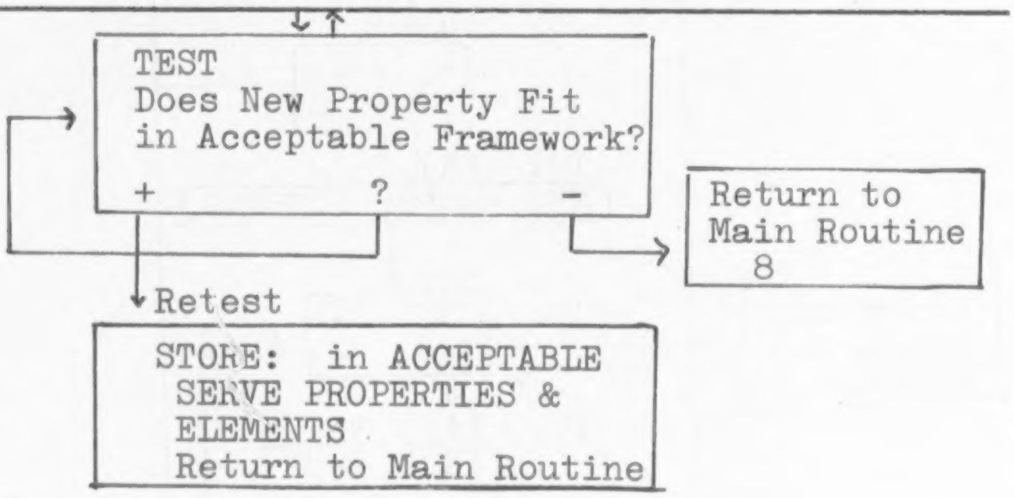
APPENDIX XCVIV (continued)


Go to 4
Go to 8
9.
(A)
C → R
+ ? -
10.
(R)
NEW PROPS. & ELEMS.
(ST.)
Acceptable Props. & Elems.
(C)
11.
SUB 20
+ -
12.
(A)
PROP. → C
+ ? -

Subgoals


SUB 16
TEST VALUE
SUB. 17
T2,T3,T1
SUB. 18
R3,R2,R1
SUB. 19
C2,C4,C3,
C5,C1
SUB. 20
READ IN
NEW PROPERTY
CALL OLD PROPERTIES:
Order of Call:
(1) Reverse
(2) Mixed
(3) Forward
GROUP PROPERTIES:
Order of Priority:
TIM, OC, F, E, RCH,
G, W, B, ARCH, LEAN,
TOP, W_hor, FEELS, HD,
W, TK, WB, BNG UP,
CON, MOC, S_14, H, P,
S_13
INDIVIDUAL PROPERTIES:
Unique to each subject

APPENDIX XCVIV (continued)


TEST
Does New Property Fit
in Acceptable Framework?
+
?
-
Return to
Main Routine
8
Retest
STORE: in ACCEPTABLE
SERVE PROPERTIES &
ELEMENTS
Return to Main Routine